ENERGY MANAGEMENT SYSTEM (EMS) STUDY

Fort Belvoir, Virginia
Department of the Army
Baltimore District
U. S. Army Corps of Engineers

COE Project No: DACA31-92-D-0061
Delivery Order No: 0004

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FINAL SUBMITTAL
VOLUME 1 OF 2

DEPARTMENT OF THE ARMY
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Energy Management System (EMS) STUDY

Fort Belvoir, Virginia

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PROJECT NUMBER: DACA31-92-D-0061
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I. EXECUTIVE SUMMARY

A. INTRODUCTION

General Location: Fort Belvoir is an 8,656 acre Post held fee simple by the US Army. It is located in the Commonwealth of Virginia, 14 miles south of Washington, D.C., situated primarily on a peninsula of the Potomac River. Interstate 95 and US Route 1 provide primary transportation links to Norfolk, Washington, DC, and other cities. Fort Belvoir is an Army Installation under the Command of the United States Military District of Washington (MDW).

Installation Mission: Since 1988 and its transfer to the MDW, Fort Belvoir's mission has shifted from training to service to MDW and the National Capitol Region (NCR). Within its eight mission elements are: contingency military support to the NCR, Regional Administrative Center, Regional Logistics Support, Regional Recreation Center, Classroom Center, Housing and other regional activities. The Installation is now referred to as "U.S. Army Fort Belvoir".

Ft. Belvoir has been tasked, by Executive Order 12902, with reducing the total energy consumption on the Installation by 30% of the FY1985 level by the year FY2005. The purpose of this study is to determine the most effective Energy Management Systems (EMS) to install to assist in meeting this challenge. The analysis performed was based upon five buildings of different function, occupancy and scheduling, as well as different types of mechanical systems. Three different EMS types were analyzed for their advantages and applicability to each building. The results of this study are to be used to evaluate other buildings on the Installation. The three types of systems analyzed for this study are the FM Relay (FMR), the Power Line Carrier (PLC) and the Direct Digital Control (DDC) Systems.

B. PURPOSE

The purpose of this study is to compare three different types of energy management systems and determine which system would be most effective in each of a variety of different buildings. The three systems chosen for this analysis are the **FM Relay (FMR)**, **Power Line Carrier (PLC)** and **Direct Digital Control (DDC)** systems. The analysis performed was based upon five buildings of different function, occupancy, and scheduling as well as different types of mechanical systems. The recommendations listed in this report are to be applied over the entire Installation using the criteria listed for evaluating each building. This study will develop the recommended strategies for applying energy management systems (EMS) to many of the buildings at Ft. Belvoir.

C. BUILDING INFORMATION

The following is a list of the buildings which were analyzed for this study:

Building 200 - 26,256 square foot recreation facility

Building 219 - 32,937 square foot finance office building w/ auditorium

Building 247 - 148,067 square foot classroom building

Building 1425 - 15,430 square foot administrative office building

Building 3136 - 11,760 square foot office building

Building energy simulations were performed for each building to determine the cost effectiveness of EMS application to each building. This information along with initial investment, maintenance and replacement costs were used to perform life cycle cost analysis for each system type being recommended.

D. PRESENT ENERGY CONSUMPTION

The estimated present energy consumption for each building is shown in Table 1 on page I-3. This table reflects the results of the energy simulation calculations for each building as it existed at the time this study was conducted. This is true for all buildings except building 1425. This building is presently equipped with a control system which utilizes a time clock to provide time of day scheduling. In an effort to provide a comparative analysis for other buildings which are similar in size and system type, but do not have time of day scheduling, it was decided that this building will be analyzed as if it were not equipped with a time clock. For this reason the results of the analysis for building 1425 are not applicable to this building but may be used as an example when evaluating other similar buildings.

Table 1. Estimated Present Annual Energy Consumption

	Building 200	Building 219	Building 247	Building 1425	Building 3136
Electrical Energy (kWH)	727,922	903,608	2,045,422	265,769	346,101
Electrical Energy (kBTU)	2,484,398	3,083,111	6,981,025	907,070	1,181,243
Electrical Cost ($)	14,558	18,072	40,908	5,315	6,922
Natural Gas (Therm)	29,904	25,043	40,071	-----	-----
Natural Gas (kBTU)	2,990,400	2,504,300	4,007,100	-----	-----
Natural Gas Cost ($)	18,182	15,226	24,363	-----	-----
District Steam (kLBS)	-----	-----	-----	254	434
District Steam (kBTU)	-----	-----	-----	340,360	581,560
District Steam Cost ($)				2,034	3,472
Total Annual Energy (kBTU)	5,474,798	5,587,411	10,988,125	1,247,564	1,762,334

E. ENERGY CONSERVATION ANALYSIS

ECOs Investigated

The following is a list of the ECOs investigated for this study:

Building 200
- FMR EMS
- PLC EMS
- DDC EMS

Building 219
- FMR EMS
- PLC EMS
- DDC EMS

Building 247
- FMR EMS
- PLC EMS
- DDC EMS

Building 1425
- FMR EMS
- PLC EMS
- DDC EMS

Building 3136
- FMR EMS
- PLC EMS
- DDC EMS

ECOs Recommended
The following is a list of the ECOs recommended as a result of this study:

Building 200	DDC
Building 219	DDC
Building 247	DDC
Building 1425	FMR, PLC
Building 3136	FMR

*The recommendations made for building 1425 are for comparison of similar buildings which are not equipped with an EMS. They do not apply to building 1425.

ECOs Rejected
The following is a list of ECOs which were rejected as a result of this study

Building 200
- FMR
- PLC

Building 219
- FMR
- PLC

Building 247
- FMR
- PLC

Building 1425

- DDC

Building 3136
- PLC
- DDC

The above listed ECO recommendations and rejections are based on the following criteria:

Building 200, 219, and 247:
Although the FMR system results in the highest SIR and the shortest payback period, this system does not provide comprehensive EMS capability and will not save energy. As shown in the capabilities summary the FMR is capable of demand limiting only. This eliminates the FMR from consideration as a solution to the problem of reducing the total energy consumption for the entire Ft Belvoir Installation. This system should be considered, however, for use with any building which has comfort cooling using electric chillers or condensing units and is not equipped with an EMS which is capable of demand limiting. Because of the short payback period and ease of installation, the FMR can be applied in a temporary fashion to buildings which may be scheduled for EMS installation beyond 2 years in the future. FMR systems installed for this purpose can be removed, after the new EMS is installed, and then re-used for another building on the Installation. When installing the FMR system care must be taken to ensure that the relays are used to initiate a normal equipment shut-down and not to simple disconnect the incoming power to the equipment. Until the entire Installation is outfitted with an EMS that is capable of demand limiting, the FMR should be applied as described above to generate cost savings at a very attractive SIR.

The PLC provides an substantial energy savings and SIR for each individual building as shown in Table 1 on page I-3, Table 2 on page I-11 and Table 3 on page I-12. The system, as evaluated in this study, is capable of providing time of day scheduling which accounts for the majority of energy savings attributable to this type of EMS. The PLC performs this time of day scheduling at the lower cost and a higher SIR than the DDC system.

The DDC system provides the greatest energy savings potential of the three systems evaluated, as shown in Tables 1 through 3. This is important as Ft. Belvoir continues toward the goal of reducing the total energy consumption by 30% of the FY1985 levels by the year FY2005. In addition to the increased energy savings potential the DDC system offers several features which are not available on the typical PLC system. These features, which are important ingredients for a comprehensive EMS in a multiple building Installation such as, Ft. Belvoir are as follows:

- On-Line monitoring and control of the building systems from a central location. The DDC system provides this capability through a network arrangement which can utilize the existing fiber optics at Ft. Belvoir or dedicated phone lines between the various buildings. The typical PLC is capable of only intermittent communications via a modem in a central computer and the controller in each building.

- Demand limiting based on an Installation-wide strategy which monitors the electric demand at the main electric sub-station providing power to all of Ft. Belvoir. The PLC is capable of demand limiting or load shedding within each individual building only. It is not capable of controlling the demand strategy for all of the buildings on the Installation. The DDC system can be equipped to continuously monitor the electric demand from a meter at the sub-station and implement the appropriate demand limiting strategy for every building connected to a central control computer. This integrated approach is necessary at Ft. Belvoir because the demand charges assessed by the electric company are based on the maximum electric demand for the entire Installation not for the individual buildings.

- Increased control system reliability and maintainability. The DDC system installation will require the replacement of many of the existing pneumatic sensors, controllers and actuators each system. For this reason the control system reliability will be significantly increased in two ways. First the new components will be replacing components which are, in many cases over twenty years old and second the sensors and controllers used in the modern DDC systems are superior in many ways to the older pneumatic components. The DDC systems also require less maintenance since all of the logic functions are performed by solid state controllers with no moving parts as compared to the old pneumatic receiver controllers and logic controllers which require periodic calibration. The economic impact attributable to this increased reliability is impossible to accurately estimate but is generally thought to be significant in most cases. The PLC system utilizes all of the existing control components and will not increase the reliability or maintainability of the control systems.

Building 1425:

The FMR EMS should be installed on the chiller serving this building, because of the short payback period and ease of installation, the FMR can be applied When installing the FMR system care must be taken to ensure that the relays are used to initiate a normal equipment shut-down and not to simple disconnect the incoming power to the equipment. The existing control system in this building is currently equipped with the capability to provide the time-of-day scheduling which has been shown in this study to provide the largest single economic advantage of an EMS. Therefore, it is not advisable to install an EMS with time-of-day scheduling capabilities.

When analyzing similar size buildings served primarily by perimeter fan-coil units and central air cooled chilled water, and district steam heated hot water systems the PLC should be considered as an option for maximum energy savings while meeting ECIP funding criteria.

For new buildings or buildings where major mechanical renovation is planned the DDC system will should be considered for applications similar to this building. Because the DDC system would provide all of the control system and EMS capabilities the required investment in the EMS portion would be considerably less than "adding" EMS capabilities to existing systems.

Building 3136:

The age and condition of the fan coil units and the control system in this building make it a candidate for a mechanical system replacement. An example is that the fan coil units are not equipped with control valves to stop the flow of water through coil when cooling or heating is not needed. This situation causes the fan coil units to act as radiators during the heating season even after the thermostat has been satisfied and has cycled the fan off. The installation of total system EMS at the time of new equipment installation would be more cost effective.

The building is served by a packaged air cooled chiller which can be cycled to provide electrical demand savings. This building should be equipped with and FMR relay and entered into a demand limiting schedule in accordance with the strategy outlined in Example 2.1 on page II-2 of this report.

ECIP Projects Developed
The following is a list of ECIP Projects developed as a result of this study:

Building 200 - DDC EMS	SIR 1.93
Building 219 - DDC EMS	SIR 2.03
Building 247 - DDC EMS	SIR 1.91
Building 1425 -FMR EMS	SIR 7.17
- PLC EMS*	SIR 1.55
Building 3136 - FMR EMS	SIR 7.17

*The PLC recommendation made for building 1425 are for comparison of similar buildings which are not equipped with an EMS. This does not apply to building 1425.

The supporting data for these projects is shown in tabular form in Section F of this summary along with the Life Cycle Cost Analysis Sheets for the ECIP Projects.

F. EXTRAPOLATION OF RESULTS

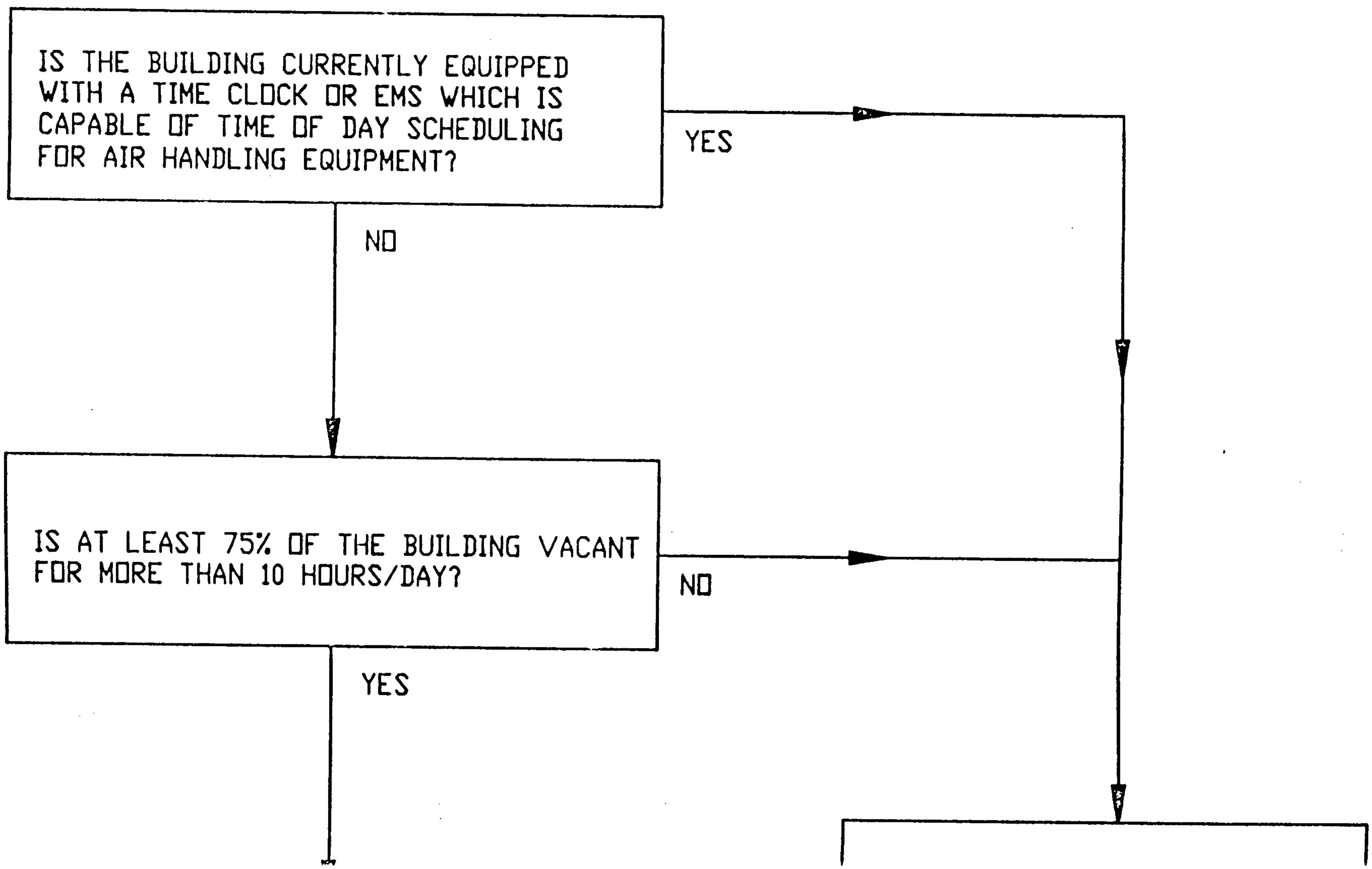
Based on the results of this study the DDC EMS provides the greatest benefit of all the system evaluated for this study. The benefits of the DDC system can best be utilized by installing the systems with an emphasis on Installation-wide control and monitoring. This can be accomplished most effectively by packaging all of the buildings on the post which meet the criteria for EMS installation and acquiring competitive bids from qualified manufacturers and installers with experience in large multiple building Installations. It is also important to specify the requirement that all of the buildings be linked to a central control computer via a network arrangement utilizing the existing fiber optic facilities where possible and dedicated phone lines elsewhere. Another major consideration in evaluation of the manufacturers and installers is the availability and reliability of the support personnel who will be responsible for maintaining the system. It is also important that the manufacturers provide sufficient training for Installation or contract personnel who are responsible for maintaining the mechanical equipment.

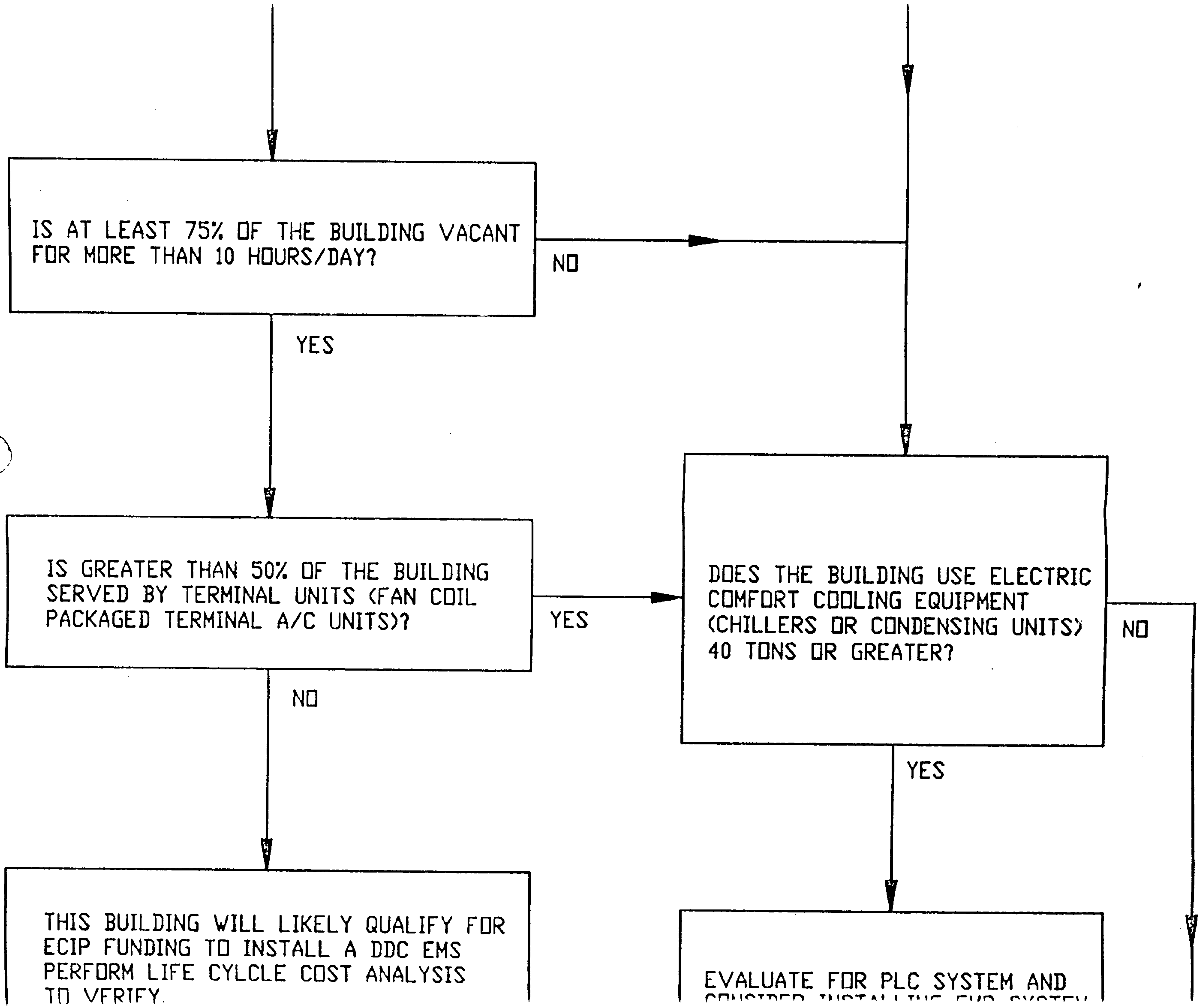
If it is not possible to perform a full scale Installation-wide implementation of the DDC systems as described above, an alternate approach can be taken. The alternate approach would be to divide the Installation into groups of buildings and acquire competitive bids for each individual group as funding becomes available. The disadvantage to utilizing this alternative approach is that the different manufacturers will likely be used for each group of buildings. This would require the installation of a central control computer for each different manufacturer or an integration package would be required to consolidate the systems into one central control computer. There are manufacturers who are currently providing integration packages which are capable of communicating with the systems of major control manufacturers. Care must be taken to specify that the control manufacturers and the integrator's systems must are compatible.

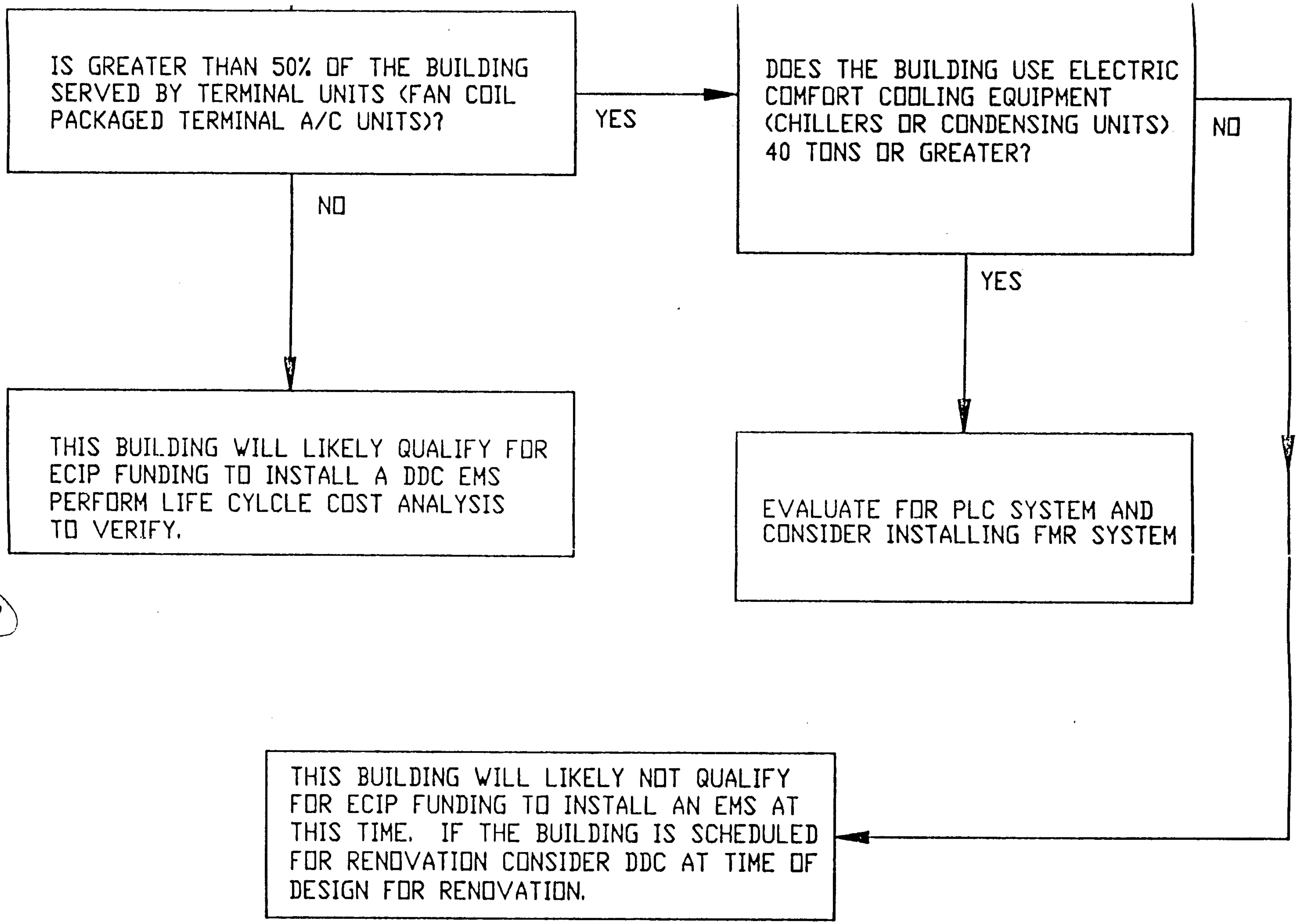
For small buildings which are served primarily by perimeter fan-coil units and central air cooled chilled water, and district steam heated hot water systems the PLC should be considered as an option for maximum energy savings while meeting ECIP funding criteria. These PLC systems should be limited in use to smaller buildings up to 20,000 sq. ft. and two stories or less with simple AC power distribution systems. The PLC systems have reportedly experienced operating problems when connected to AC power system which have a high level of electronic equipment usage. The availability of competitive vendors is limited and care should be taken when selecting systems to chose vendors with a documented history of successful installations similar to the application being considered.

The results of this study can also be extrapolated to assist energy auditors in selecting buildings for EMS implementation. The flow chart on the following page can be used as a preliminary test in selecting these buildings.

EMS BUILDING EVALUATION FLOWCHART




IS AT LEAST 75% OF THE BUILDING VACANT FOR MORE THAN 10 HOURS/DAY?
NO
YES
IS GREATER THAN 50% OF THE BUILDING SERVED BY TERMINAL UNITS (FAN COIL PACKAGED TERMINAL A/C UNITS)?
YES
NO
DOES THE BUILDING USE ELECTRIC COMFORT COOLING EQUIPMENT (CHILLERS OR CONDENSING UNITS) 40 TONS OR GREATER?
NO
YES
THIS BUILDING WILL LIKELY QUALIFY FOR ECIP FUNDING TO INSTALL A DDC EMS PERFORM LIFE CYLCLE COST ANALYSIS TO VERIFY.
EVALUATE FOR PLC SYSTEM AND


IS GREATER THAN 50% OF THE BUILDING SERVED BY TERMINAL UNITS (FAN COIL PACKAGED TERMINAL A/C UNITS)?
YES
NO
DOES THE BUILDING USE ELECTRIC COMFORT COOLING EQUIPMENT (CHILLERS OR CONDENSING UNITS) 40 TONS OR GREATER?
NO
YES
THIS BUILDING WILL LIKELY QUALIFY FOR ECIP FUNDING TO INSTALL A DDC EMS PERFORM LIFE CYLCLE COST ANALYSIS TO VERIFY.
EVALUATE FOR PLC SYSTEM AND CONSIDER INSTALLING FMR SYSTEM
THIS BUILDING WILL LIKELY NOT QUALIFY FOR ECIP FUNDING TO INSTALL AN EMS AT THIS TIME. IF THE BUILDING IS SCHEDULED FOR RENOVATION CONSIDER DDC AT TIME OF DESIGN FOR RENOVATION.

3

Because the recommended control strategy for DDC installation involves Installation-wide systems, it may be necessary to implement these systems in buildings which do not show a payback. This is true because the goal is to maximize the energy savings for the entire Installation.

G. TABULATION OF RESULTS

Tables 2 on page I-11, Table 3 on page I-12 and Table 4 on page I-13, list the results of the energy conservation analyses for each investigated Energy Conservation Opportunity (ECO). In addition, the EMS Capability Summary Tables compare the features of each system and their advantages and disadvantages relative to each building studied.

Life Cycle Cost Analysis Summary Sheets are included for all developed projects meeting ECIP Criteria.

TABLE 2

BUILDING	ECO	TOTAL SAVINGS $	INITIAL INVESTMENT $	SIR	SIMPLE PAYBACK YEAR(S)	TOTAL ANNUAL ENERGY SAVINGS KBTU	REMARKS
Building 200	FMR	14,909	1,115	13.37	1	0	
	PLC	59,601	12,711	4.69	3	981,343	
	DDC	152,246	78,764	1.93	5	1,489,047	
Building 219	FMR	14,979	1,673	8.95	1	0	
	PLC	91,836	12,516	7.34	2	1,583,582	
	DDC	146,518	72,141	2.03	5	1,725,602	
Building 247	FMR	26,923	558	48.29	1	0	
	PLC	108,303	14,914	7.26	2	1,837,268	
	DDC	166,883	87,416	1.91	5	2,043,868	
Building 1425	FMR	3,999	558	7.17	2	0	
	PLC	17,893	11,518	1.55	6	297,889	*
	DDC	33,374	48,993	.68	--	312,251	*
Building 3136	FMR	3,999	558	7.17	2	0	
	PLC	17,938	10,464	1.68	6	294,780	
	DDC	32,715	48,614	.67	--	322,978	

*As noted in Section III D, these figures are not applicable to Building 1425 because it is currently equipped with an EMS. These figures are for comparison to buildings which are similar but are not equipped with an EMS.

TABLE 3

BUILDING	ECO	(A) ANNUAL ELECTRICAL ENERGY SAVINGS kWh	(B) ANNUAL ELECTRICAL COST SAVINGS $ (A x $.02)	© ANNUAL NATURAL GAS SAVINGS THERM	(D) ANNUAL NATURAL GAS SAVINGS $ (C x $.608)	(E) ANNUAL DISTRICT STEAM SAVINGS kLBS	(F) ANNUAL DISTRICT STEAM SAVINGS $ (E x $8.0)	(G) ANNUAL ELECTRICAL DEMAND SAVINGS $	(H) TOTAL ANNUAL COST SAVINGS $ (B+D+F+G)
Building 200	FMR	0	0	0	0	-----	-----	1,700	1,700
	PLC	60,956	1,219	7,733	4,702	-----	-----	0	5,921
	DDC	99,545	1,991	11,493	6,988	-----	-----	1,700	10,679
Building 219	FMR	0	0		0	-----	-----	1,708	1,708
	PLC	207,057	4,141	8,778	5,337	-----	-----	0	9,478
	DDC	225,961	4,519	9,553	5,808	-----	-----	1,708	12,035
Building 247	FMR	0	0		0	-----	-----	3,070	3,070
	PLC	195,215	3,904	11,710	7,120	-----	-----	0	11,024
	DDC	218,186	4,364	12,992	7,899	-----	-----	3,070	15,333
Building 1425	FMR	0	0	-----	-----	0	0	456	491
	PLC	16,374	328	-----	-----	180	1,440	0	1,768
	DDC	19,208	384	-----	-----	184	1,472	456	2,312
Building 3136	FMR	0	0	-----	-----	0	0	456	456
	PLC	10,104	202	-----	-----	194	1,552	0	1,754
	DDC	13,890	278	-----	-----	206	1,648	456	2,382

TABLE 4

BUILDING	ECO	ANNUAL ENERGY USAGE kBTU	ANNUAL ENERGY SAVINGS kBTU	ENERGY SAVINGS PERCENTAGE %
Building 200	BASELINE	5,474,798	----------	-------
	FMR	5,474,798	0	0
	PLC	4,493,455	981,343	18%
	DDC	3,985,751	1,489,047	27%
Building 219	BASELINE	5,587,411	-----------	--------
	FMR	5,587,411	0	0%
	PLC	4,003,829	1,583,582	28%
	DDC	3,861,809	1,725,602	31%
Building 247	BASELINE	10,988,125	-----------	--------
	FMR	10,988,125	0	0%
	PLC	9,150,857	1,837,268	17%
	DDC	8,944,257	2,043,868	19%
Building 1425	BASELINE	1,247,564	-----------	
	FMR	1,247,564	0	0%
	PLC	949,675	297,889	24%
	DDC	935,313	312,251	25%
Building 3136	BASELINE	1,762,334	-----	-----
	FMR	1,762,334	0	0%
	PLC	1,467,554	294,780	17%
	DDC	1,439,356	322,978	18%

EMS Capability Summary - Building 200

FEATURES:	FMR	PLC	DDC
Chilled Water Reset			X
Hot Water Reset			X
Supply Air Reset			X
Enthalpy Economizer			X
Time of Day Scheduling		X	X
Night Setback			X
Demand Limiting	X		X
"On-Line" Centralized Control			X
"On-Line" Centralized Monitoring			X
Expandability		X	X
Flexibility		X	X
Maintenance Scheduling			X
Optimum Start		X	X
Occupant Control/Override		X	X
Comfort Control		X	X
ADVANTAGES:			
Increased Control System Reliability/Maintainability			X
Increased Equipment and Control System Life			X
Highest Savings - To- Investment Ratio (SIR)	X		
Provides Highest Total Energy Savings			X
Meets ECIP Funding Criteria	X	X	X
DISADVANTAGES:			
Highest Initial Cost			X
No Energy Savings	X		
Does Not Meet ECIP Funding Criteria			

EMS Capability Summary - Building 219

FEATURES:	EMR	PLC	DDC
Chilled Water Reset			X
Hot Water Reset			X
Supply Air Reset			X
Enthalpy Economizer			X
Time of Day Scheduling		X	X
Night Setback			X
Demand Limiting	X		X
"On-Line" Centralized Control			X
"On-Line" Centralized Monitoring			X
Expandability		X	X
Flexibility		X	X
Maintenance Scheduling			X
Optimum Start		X	X
Occupant Control/Override		X	X
Comfort Control		X	X
ADVANTAGES:			
Increased Control System Reliability/Maintainability			X
Increased Equipment and Control System Life			X
Highest Savings - To- Investment Ratio (SIR)	X		
Provides Highest Total Energy Savings			X
Meets ECIP Funding Criteria	X	X	X
DISADVANTAGES:			
Highest Initial Cost			X
No Energy Savings	X		
Does Not Meet ECIP Funding Criteria			

EMS Capability Summary - Building 247

FEATURES:	FMR	PLC	DDC
Chilled Water Reset			X
Hot Water Reset			X
Supply Air Reset			X
Enthalpy Economizer			X
Time of Day Scheduling		X	X
Night Setback			X
Demand Limiting	X		X
"On-Line" Centralized Control			X
"On-Line" Centralized Monitoring			X
Expandability		X	X
Flexibility		X	X
Maintenance Scheduling			X
Optimum Start		X	X
Occupant Control/Override		X	X
Comfort Control		X	X
ADVANTAGES:			
Increased Control System Reliability/Maintainability			X
Increased Equipment and Control System Life			X
Highest Savings - To- Investment Ratio (SIR)	X		
Provides Highest Total Energy Savings			X
Meets ECIP Funding Criteria	X	X	X
DISADVANTAGES:			
Highest Initial Cost			X
No Energy Savings	X		
Does Not Meet ECIP Criteria			

EMS Capability Summary - Building 1425

FEATURES:	FMR	PLC	DDC
Chilled Water Reset			X
Hot Water Reset			X
Supply Air Reset	N/A	N/A	N/A
Enthalpy Economizer	N/A	N/A	N/A
Time of Day Scheduling		X	X
Night Setback			X
Demand Limiting	X		X
"On-Line" Centralized Control			X
"On-Line" Centralized Monitoring			X
Expandability		X	X
Flexibility		X	X
Maintenance Scheduling			X
Optimum Start		X	X
Occupant Control/Override		X	X
Comfort Control		X	X
ADVANTAGES:			
Increased Control System Reliability/Maintainability			X
Increased Equipment and Control System Life			X
Highest Savings - To- Investment Ratio (SIR)	X		
Provides Highest Total Energy Savings			X
Meets ECIP Funding Criteria	X	X	
DISADVANTAGES:			
Highest Initial Cost			X
No Energy Savings	X		
Does Not Meet ECIP Funding Criteria			X

EMS Capability Summary - Building 3136

FEATURES:	FMR	PLC	DDC
Chilled Water Reset			X
Hot Water Reset			X
Supply Air Reset	N/A	N/A	N/A
Enthalpy Economizer	N/A	N/A	N/A
Time of Day Scheduling		X	X
Night Setback			X
Demand Limiting	X		X
"On-Line" Centralized Control			X
"On-Line" Centralized Monitoring			X
Expandability		X	X
Flexibility		X	X
Maintenance Scheduling			X
Optimum Start		X	X
Occupant Control/Override		X	X
Comfort Control		X	X
ADVANTAGES:			
Increased Control System Reliability/Maintainability			X
Increased Equipment and Control System Life			X
Highest Savings - To- Investment Ratio (SIR)	X		
Provides Highest Total Energy Savings			X
Meets Funding Criteria	X	X	
DISADVANTAGES:			
Highest Initial Cost			X
No Energy Savings	X		
Does Not Meet ECIP Funding Criteria			X

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Belvoir, VA REGION NO. 3 PROJECT NO. DACA-31-92 D0061 Del. Order 4
PROJECT TITLE: Ft. Belvoir EMS Study FISCAL YEAR 95
DISCRETE PORTION NAME: BUILDING 200 - DDC EMS INSTALLATION ECIP No.____

ANALYSIS DATE: 1/95 ECONOMIC LIFE: 10 YEARS PREPARER: EINHORN YAFFEE PRESCOTT

1. INVESTMENT COSTS:

A. CONSTRUCTION COST	$70,640
B. SIOH	$4,238
C. DESIGN COST	$3,885
D. TOTAL COST (1A+1B+1C)	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	
F. PUBLIC UTILITY COMPANY REBATE	
G. TOTAL INVESTMENT (1D-1E-1F)	$78,763

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR -4942-1 USED FOR DISCOUNT FACTORS (Oct 1994)) DISCOUNT RATE: 3.1%

ENERGY	COST $ / MBTU (1)	SAVINGS MBTU / YR (2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELEC	5.86	339.7	$1,991	8.82	$17,561
B. DIST	5.97				
C. RESID					
D. NG	6.08	1149.3	$6,988	9.86	$68,902
G.					
H. DEMAND SAVINGS			$1,700	8.49	$14,433
I. TOTAL			$10,679		$100,896

3. NON-ENERGY SAVINGS (+) OR COST (-):

A.	ANNUAL RECURRING (+/-)	$5,560		
(1)	DISCOUNT FACTOR (TABLE A)		8.49	
(2)	DISCOUNTED SAVINGS/COST (3A X 3A1)			$47,204

B. NON-RECURRING SAVINGS (+) OR COST (-)

		SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-) (4)
a.					$0
b.					$0
c.					$0
d.	TOTAL	$0			$0

C.	TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3bD4)	$61,637
4.	SIMPLE PAYBACK (1G / (2I3+3A+ (3Bd1 / ECONOMIC LIFE))):	4.9 YEARS
5.	TOTAL NET DISCOUNTED SAVINGS (2I5+3C):	$148,100
6:	SAVINGS TO INVESTMENT RATIO (SIR) (5/1G):	1.88
7.	ADJUSTED INTERNAL RATE OF RETURN (AIRR):	9.82%

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Belvoir, VA REGION NO. 3 PROJECT NO. DACA-31-92 D0061 Del. Order 4
PROJECT TITLE: Ft. Belvoir EMS Study FISCAL YEAR 95
DISCRETE PORTION NAME: BUILDING 219 - DDC EMS INSTALLATION ECIP No.____

ANALYSIS DATE: 1/95 ECONOMIC LIFE: 10 YEARS PREPARER: EINHORN YAFFEE PRESCOTT

1. INVESTMENT COSTS:

A.	CONSTRUCTION COST	$64,700
B.	SIOH	$3,882
C.	DESIGN COST	$3,559
D.	TOTAL COST (1A+1B+1C)	
E.	SALVAGE VALUE OF EXISTING	
F.	PUBLIC UTILITY COMPANY REBATE	
G.	TOTAL INVESTMENT (1D-1E-1F)	$72,141

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR -4942-1 USED FOR DISCOUNT FACTORS (Oct 1994)) DISCOUNT RATE: 3.1%

ENERGY	COST $ / MBTU (1)	SAVINGS MBTU / YR (2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELEC	5.86	770.3	$4,514	8.82	$39,813
B. DIST	5.97				
C. RESID					
D. NG	6.08	955.3	$5,808	9.86	$57,267
G. OTHER					
H. DEMAND SAVINGS			$1,708	8.49	$14,501
I. TOTAL			$12,028		$111,581

3. NON-ENERGY SAVINGS (+) OR COST (-):

A.	ANNUAL RECURRING (+/-)	$3,710		
(1)	DISCOUNT FACTOR (TABLE A)		8.49	
(2)	DISCOUNTED SAVINGS/COST (3A X 3A1)			$31,498

B. NON-RECURRING SAVINGS (+) OR COST (-)

		SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-) (4)
a.					$0
b.					$0
c.					$0
d.	TOTAL	$0			$0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3bD4) $45,999

4.	SIMPLE PAYBACK (1G / (2I3+3A+ (3Bd1 / ECONOMIC LIFE))):	4.6 YEARS
5.	TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$143,079
6:	SAVINGS TO INVESTMENT RATIO (SIR) (5/1G):	1.98
7.	ADJUSTED INTERNAL RATE OF RETURN (AIRR):	10.40%

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Belvoir, VA REGION NO. 3 PROJECT NO. DACA-31-92 D0061 Del. Order 4
PROJECT TITLE: Ft. Belvoir EMS Study FISCAL YEAR 95
DISCRETE PORTION NAME: BUILDING 247 - DDC EMS ECIP No._____
ANALYSIS DATE: 1/95 ECONOMIC LIFE: 10 YEARS PREPARER: EINHORN YAFFEE PRESCOTT

1. INVESTMENT COSTS:

A.	CONSTRUCTION COST	$78,400
B.	SIOH	$4,704
C.	DESIGN COST	$4,312
D.	TOTAL COST (1A+1B+1C)	
E.	SALVAGE VALUE OF EXISTING	
F.	PUBLIC UTILITY COMPANY REBATE	
G.	TOTAL INVESTMENT (1D-1E-1F)	$87,416

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR -4942-1 USED FOR DISCOUNT FACTORS (Oct 1994)) DISCOUNT RATE: 3.1%

ENERGY	COST $ / MBTU (1)	SAVINGS MBTU / YR (2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELEC	5.86	744.7	$4,364	8.82	$38,490
B. DIST	5.97				
C. RESID					
D. NG	6.08	1299.2	$7,899	9.86	$77,884
G. OTHER					
H. DEMAND SAVINGS			$3,070	8.49	$26,064
I. TOTAL		2044	$15,333		$142,438

3. NON-ENERGY SAVINGS (+) OR COST (-):

A.	ANNUAL RECURRING (+/-)	$2,300		
(1)	DISCOUNT FACTOR (TABLE A)		8.49	
(2)	DISCOUNTED SAVINGS/COST (3A X 3A1)			$19,527

B. NON-RECURRING SAVINGS (+) OR COST (-)

		SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-) (4)
a.					$0
b.					$0
c.					$0
d.	TOTAL	$0			$0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3bD4) $19,527

4.	SIMPLE PAYBACK (1G / (2I3+3A+ (3Bd1 / ECONOMIC LIFE))):	5.0	YEARS
5.	TOTAL NET DISCOUNTED SAVINGS (2I5+3C):	$161,965	
6:	SAVINGS TO INVESTMENT RATIO (SIR) (5/1G):	1.85	
7.	ADJUSTED INTERNAL RATE OF RETURN (AIRR):	7.65%	

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Belvoir, VA REGION NO. 3 PROJECT NO. DACA-31-92 D0061 Del. Order 4
PROJECT TITLE: Ft. Belvoir EMS Study FISCAL YEAR 95
DISCRETE PORTION NAME: BUILDING 1425 - PLC EMS ECIP No.____

ANALYSIS DATE: 1/95 ECONOMIC LIFE: 10 YEARS PREPARER: EINHORN YAFFEE PRESCOTT

1. INVESTMENT COSTS:

A.	CONSTRUCTION COST	$10,330
B.	SIOH	$620
C.	DESIGN COST	$568
D.	TOTAL COST (1A+1B+1C)	
E.	SALVAGE VALUE OF EXISTING	
F.	PUBLIC UTILITY COMPANY REBATE	
G.	TOTAL INVESTMENT (1D-1E-1F)	$11,518

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR -4942-1 USED FOR DISCOUNT FACTORS (Oct 1994)) DISCOUNT RATE: 3.1%

ENERGY	COST $ / MBTU (1)	SAVINGS MBTU / YR (2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELEC	5.86	55.9	$328	8.82	$2,893
B. DIST	5.97				
C. RESID					
D. NG	6.08	242.0	$1,471	9.86	$14,504
G. OTHER					
H. DEMAND SAVINGS					$0
I. TOTAL		298	$1,799		$17,397

3. NON-ENERGY SAVINGS (+) OR COST (-):

A.	ANNUAL RECURRING (+/-)	$0		
(1)	DISCOUNT FACTOR (TABLE A)			
(2)	DISCOUNTED SAVINGS/COST (3A X 3A1)			$0

B. NON-RECURRING SAVINGS (+) OR COST (-)

	SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-) (4)
a.				$0
b.				$0
c.				$0
d. TOTAL	$0			$0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3bD4) $0

4. SIMPLE PAYBACK (1G / (2I3+3A+ (3Bd1 / ECONOMIC LIFE))):	6.4	YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2I5+3C):	$17,397	
6: SAVINGS TO INVESTMENT RATIO (SIR) (5/1G):	1.51	
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	7.44%	

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Belvoir, VA REGION NO. 3 PROJECT NO. DACA-31-92 D0061 Del. Order 4
PROJECT TITLE: Ft. Belvoir EMS Study FISCAL YEAR 95
DISCRETE PORTION NAME: BUILDING 1425 - FMR EMS ECIP No.

ANALYSIS DATE: 1/95 ECONOMIC LIFE: 10 YEARS PREPARER: EINHORN YAFFEE PRESCOTT

1. INVESTMENT COSTS:

A.	CONSTRUCTION COST	$500
B.	SIOH	$30
C.	DESIGN COST	$28
D.	TOTAL COST (1A+1B+1C)	
E.	SALVAGE VALUE OF EXISTING	
F.	PUBLIC UTILITY COMPANY REBATE	
G.	TOTAL INVESTMENT (1D-1E-1F)	$558

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR -4942-1 USED FOR DISCOUNT FACTORS (Oct 1994)) DISCOUNT RATE: 3.1%

ENERGY	COST $ / MBTU (1)	SAVINGS MBTU / YR (2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELEC	5.86	0	$0	8.82	$0
B. DIST	5.97				
C. RESID					
D. NG	6.08	0	$0	9.86	$0
G. OTHER					
H. DEMAND SAVINGS			$456	8.49	$3,871
I. TOTAL		0	$0		$3,871

3. NON-ENERGY SAVINGS (+) OR COST (-):

A.	ANNUAL RECURRING (+/-)	$0		
(1)	DISCOUNT FACTOR (TABLE A)		8.11	
(2)	DISCOUNTED SAVINGS/COST (3A X 3A1)			$0

B. NON-RECURRING SAVINGS (+) OR COST (-)

	SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-) (4)
a.				$0
b.				$0
c.				$0
d. TOTAL	$0			$0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3bD4)	$0
4. SIMPLE PAYBACK (1G / (2I3+3A+ (3Bd1 / ECONOMIC LIFE))):	1.2 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$3,871
6: SAVINGS TO INVESTMENT RATIO (SIR) (5/1G):	6.94
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	22.7%

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: Ft. Belvoir, VA REGION NO. 3 PROJECT NO. DACA-31-92 D0061 Del. Order 4
PROJECT TITLE: Ft. Belvoir EMS Study FISCAL YEAR 95
DISCRETE PORTION NAME: BUILDING 3136 - FMR EMS ECIP No.

ANALYSIS DATE: 1/95 ECONOMIC LIFE: 10 YEARS PREPARER: EINHORN YAFFEE PRESCOTT

1. INVESTMENT COSTS:

A.	CONSTRUCTION COST	$500
B.	SIOH	$30
C.	DESIGN COST	$28
D.	TOTAL COST (1A+1B+1C)	
E.	SALVAGE VALUE OF EXISTING	
F.	PUBLIC UTILITY COMPANY REBATE	
G.	TOTAL INVESTMENT (1D-1E-1F)	$558

2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR -4942-1 USED FOR DISCOUNT FACTORS (Oct 1994)) DISCOUNT RATE: 3.1%

ENERGY	COST $ / MBTU (1)	SAVINGS MBTU / YR (2)	ANNUAL $ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELEC	5.86	0	$0	8.82	$0
B. DIST	5.97				
C. RESID					
D. NG	6.08	0	$0	9.86	$0
G. OTHER					
H. DEMAND SAVINGS			$456	8.49	$3,871
I. TOTAL		0	$0		$3,871

3. NON-ENERGY SAVINGS (+) OR COST (-):

A.	ANNUAL RECURRING (+/-)	$0		
(1)	DISCOUNT FACTOR (TABLE A)		8.11	
(2)	DISCOUNTED SAVINGS/COST (3A X 3A1)			$0

B. NON-RECURRING SAVINGS (+) OR COST (-)

	SAVINGS (+) COST (-) (1)	YEAR OF OCCUR. (2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-) (4)
a.				$0
b.				$0
c.				$0
d. TOTAL	$0			$0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2+3bD4)	$0
4. SIMPLE PAYBACK (1G / (2I3+3A+ (3Bd1 / ECONOMIC LIFE))):	1.2 YEARS
5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):	$3,871
6: SAVINGS TO INVESTMENT RATIO (SIR) (5/1G):	6.94
7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	22.7%

II. INTRODUCTION

A. PURPOSE

The purpose of this study is to compare three different types of energy management systems and determine which system would be most effective in each of a variety of different buildings. The three systems chosen for this analysis are the **FM Relay (FMR)**, **Power Line Carrier (PLC)** and **Direct Digital Control (DDC)** systems. The analysis performed was based upon five buildings of different function, occupancy, and scheduling as well as different types of mechanical systems. The recommendations listed in this report are to be applied over the entire Installation using the criteria listed for evaluating each building. This study will develop the recommended strategies for applying energy management systems (EMS) to many of the buildings at Ft. Belvoir.

B. METHODOLOGY

The analysis portion of this study is based on field surveys which were conducted over a two month period. All five buildings were surveyed and mechanical equipment and control information was documented. In addition to surveys, operating personnel and occupants were interviewed to determine the hours of usage and occupant densities. Interviews were also conducted with personnel from the energy management department at Ft. Belvoir, who operate the existing FMR system.

Each EMS type was analyzed to determine its costs, capabilities, maintenance requirements and applicability to each building. The results of this analysis are shown in an EMS Evaluation Matrix for each building and system type.

Several energy simulations were performed for each building to estimate the energy usage under different operating scenarios. For each building, a baseline simulation was performed to estimate the energy usage under the current operating conditions, and for all buildings a second simulation was performed to estimate the energy usage with an energy management system in place. Each EMS is described in Section III and the energy analysis inputs reflect the description and points list given for each system. All building simulations were performed using the **Carrier E20-II Hourly Analysis 3.04** computer program and the following parameters:

- The physical properties such as floor area, wall and roof construction, window types and sizes, lighting density, occupancy, and equipment heat gains were taken from available construction documentation and verified by field surveys. Where construction drawings were not available, the information was assumed based on known field conditions, typical building practices, and engineering judgement.

- Outside air quantities were original design values unless these numbers were not available. In these cases the values were estimated based upon louver sizes, supply and return fan capacity comparisons and coil entering conditions.

- Electric rates were based on the actual electric consumption charges of \$0.01968/kWh charged by Virginia Power. Demand charges were calculated separately as described later in this section.

- All heating fuel consumption costs are based on natural gas rates from Washington Gas and district steam heating rates as established by Ft. Belvoir, where applicable.

- For hydronic two pipe change-over systems, the cooling season is May through September with the heating season being all other times of the year. This is based on estimated change-over dates provided by Ft. Belvoir.

- The weather data used in all energy calculations was from Washington, DC because this is the closest geographical city for which the Carrier program includes the necessary data. It is assumed that the 1° F average difference in the monthly mean temperature between the Washington, DC and Ft. Belvoir conditions will not have a significant impact on the outcome of these calculations.

In addition to the computerized energy simulation, several analyses were performed to estimate the magnitude of savings from the improved control accuracy and electric demand limiting capabilities of DDC control systems. These factors where evaluated as follows:

- The increased control accuracy associated with the DDC systems will result in an increased operating efficiency for each of the buildings as compared to the existing control system. This is true because the DDC system will maintain setpoints more accurately and respond to condition changes more quickly than the existing pneumatic control systems which are typically slow at performing control logic functions and lose their calibration over time. The energy simulation program is not capable of accounting for these differences in control accuracy. It was assumed that the inaccuracies of the existing pneumatic control systems will result in an additional energy usage of approximately 5% in each building . This additional energy usage was reflected by increasing the estimated energy consumption values for the Baseline, FMS and PLC conditions by 5% before entering them into the Life Cycle Cost Analysis (LCCA) program (See Appendix K for Calculations).

- The energy simulation program is not capable of estimating the potential cost savings associated with electrical demand limiting capabilities of the EMS analyzed in this study. The potential demand savings was estimated for each building based on the example shown in figure 2.1. This savings figure was then reflected in the life cycle cost analysis by entering the value as a demand charge for the Baseline and PLC conditions, which do not include demand limiting capabilities.

Figure 2.1 Electrical Demand Limiting Strategy:
An effective strategy for demand limiting on a multi-building Installation such as Fort Belvoir is to cycle off groups of equipment during periods of high electrical demand. An example of this strategy would be to connect ten chillers to an EMS. Each chiller

would be cycled off for a period of fifteen minutes in a rotating sequence with the other chillers in the group. Utilizing this strategy, power demand could be reduced by the total kW requirement of the smallest chiller in the group. During a five hour period, any one chiller would be cycled off for no more than two fifteen minute periods. With this strategy, the demand savings attributable to any group of buildings or chillers is determined by the unit or building with the smallest electric demand which is being cycled off. For this reason groups should be selected so that the electric demand for the equipment being cycled of is approximately equal for all buildings in the group. A group of ten nominal forty ton air cooled packaged chillers with a power requirement of 55.7 kW each, when cycled in accordance with this strategy, can result in a cost savings as follows:

55.7 kW x $12.54/kW demand charge/month
= $698.5/month x 12 months/year
= $8382/year.

Because nine other chillers or buildings are necessary to make this strategy feasible without out a major effect on occupant comfort, the total savings attributable to one chiller or building would be 1/10 of the total or $838.2/year. The demand savings were reflected in the economic analysis as a demand charge for the Baseline and PLC conditions, which do not include demand limiting capabilities.

The results of the building simulations along with initial investment, maintenance costs, and demand savings were used to perform Life Cycle Cost Analysis (LCCA) for EMS implementation in each building. All LCCA were performed using **NIST Building Life Cycle Cost (BLCC) 4.0** computer program with the following parameters:

- A 10 Year study period was used, as established by the ECIP guidelines.

- The Discount Rate is 4.0%, as defined by ECIP Guidelines for 10 Year Studies.

- The Energy cost price escalation rates are based on DOE figures for industrial applications in the State of Virginia as specified by ECIP Guidelines.

An evaluation matrix was developed to compare the relative merits of the different EMS for each building. Because the FMR system provides only demand limiting capabilities and is not a comprehensive EMS it was not entered in the matrix. The following example represents the maximum values assigned to each feature used to evaluate the EMS:

Energy Management System Evaluation Matrix

FUNCTION	EMS
Hot Water Reset	1
Supply Air Reset	1
Chilled Water Reset	1
Enthalpy Economizer	2
Time of Day Scheduling	10
Demand Limiting (Installation Wide)	2
Centralized Control	2
Centralized Monitoring	2
Expandability	2
Flexibility	2
Maintenance Scheduling	2
Optimum Start	2
Occupant Control/Override	1
Comfort Control	2
Reliability/Maintainability	2
Effect on Equipment Life	2
Maintenance Costs	2
Savings to Investment Ration (SIR)	10
Total	48

This matrix is intended to provide a relative comparison of the different EMS features. The maximum values shown above were assigned based on an assumption of the relative importance of the features listed. Items which are result in direct energy and/or money savings were given the highest values, while items which result in indirect savings or increases in system performance were given lower values. The outcome of the matrix, as well as the results of the building simulations and life cycle cost analysis, were used to formulate the recommendations listed for each building. Each recommendation was then evaluated for ECIP compliance and the results of those evaluations are listed in Table 1 in the Executive Summary portion of this report.

C. EMS SYSTEM DESCRIPTIONS

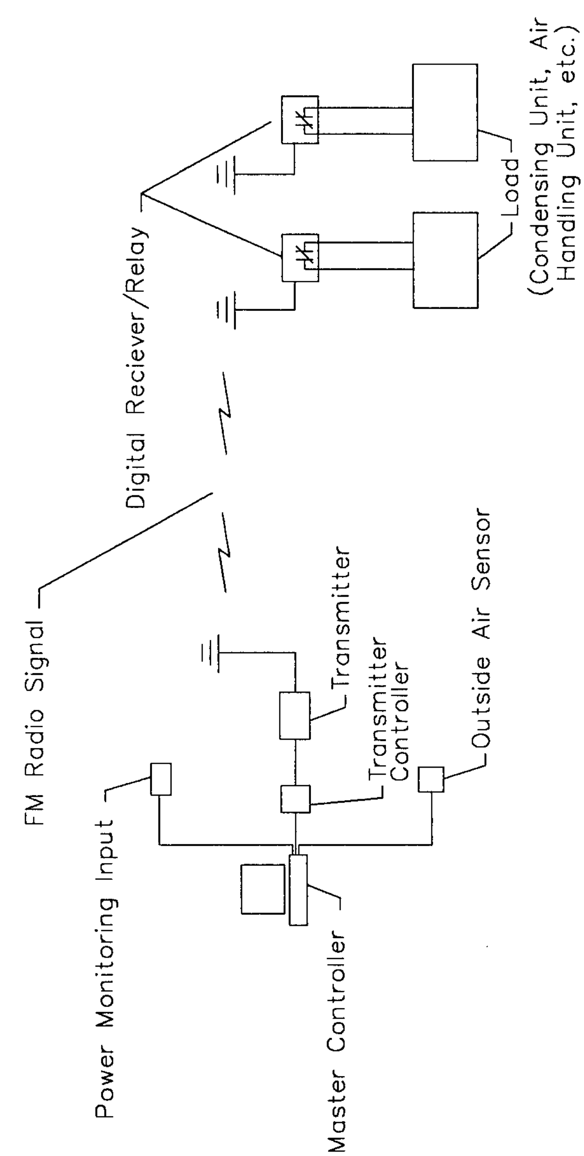
FM Relay (FMR) EMS Systems

The FMR system utilizes FM radio signals for communication between the centralized control location and individual equipment controllers. Each piece of equipment to be controlled is equipped with a digital receiver/relay which interlocks with the unit control system or incoming power supply. The relay can be used to interrupt the power to the piece of equipment or to interrupt the control signal, thus allowing remote start-stop control of the equipment. Figure 2.2 on page II-6 shows a schematic diagram of a typical FMR system. This system can be used effectively to provide simple automatic time scheduling and demand limiting for packaged commercial and residential HVAC equipment and lighting. A computer controls the time schedule for the operation of equipment and also cycles each piece of equipment as necessary to limit electric demand to a certain preset target value.

Priorities for load shedding are preset and the computer can select the appropriate cycling rate based on a variety of available input data or the cycling rate can be set manually by the operator. The system can be configured to receive electric demand information directly from a sub-station demand meter or from a series of contacts indicating that the demand status is above or below the target value. Cycling rates may also be controlled based on outside air temperatures, because a rise in electrical demand typically coincides with an increase in outside temperatures.

The FMR does not provide any temperature or safety control for the HVAC system, it will only enable or disable the equipment to which it is attached. The existing building control system must be maintained to perform all temperature and safety control functions. There is also no user over-ride function for this type of system.

Figure 2.2: FM Relay System Schematic



This type of system is currently used most often by utility companies to limit the electrical demand on their distribution network by cycling air conditioning systems and water heaters in residences and small commercial establishments.

A Scientific Atlanta FMR system is currently in operation at Fort Belvoir and is used for demand limiting in most of the housing units and approximately twenty administrative and support buildings. The installation of a new PC based master controller has greatly enhanced the system capacity and capabilities. The system is now capable of supporting 2094 different address codes and will accept contact closure, analog and/or pulse input data. The Installation is currently utilizing only a fraction of the available address codes, leaving a great deal of room for expansion of this system.

Due to the fact that the FMR operates on a one way communication principal and cannot be integrated into a total building HVAC control system it should be utilized only for on/off control of major HVAC components for demand limiting. The systems can be used very effectively to turn off HVAC equipment such as chillers and cooling tower fans for short periods of time to control electrical demand in a building or multiple building Installation. Figure 2.1 on page II-2 shows and example of an effective peak shaving strategy for a multiple building Installation such as Ft. Belvoir.

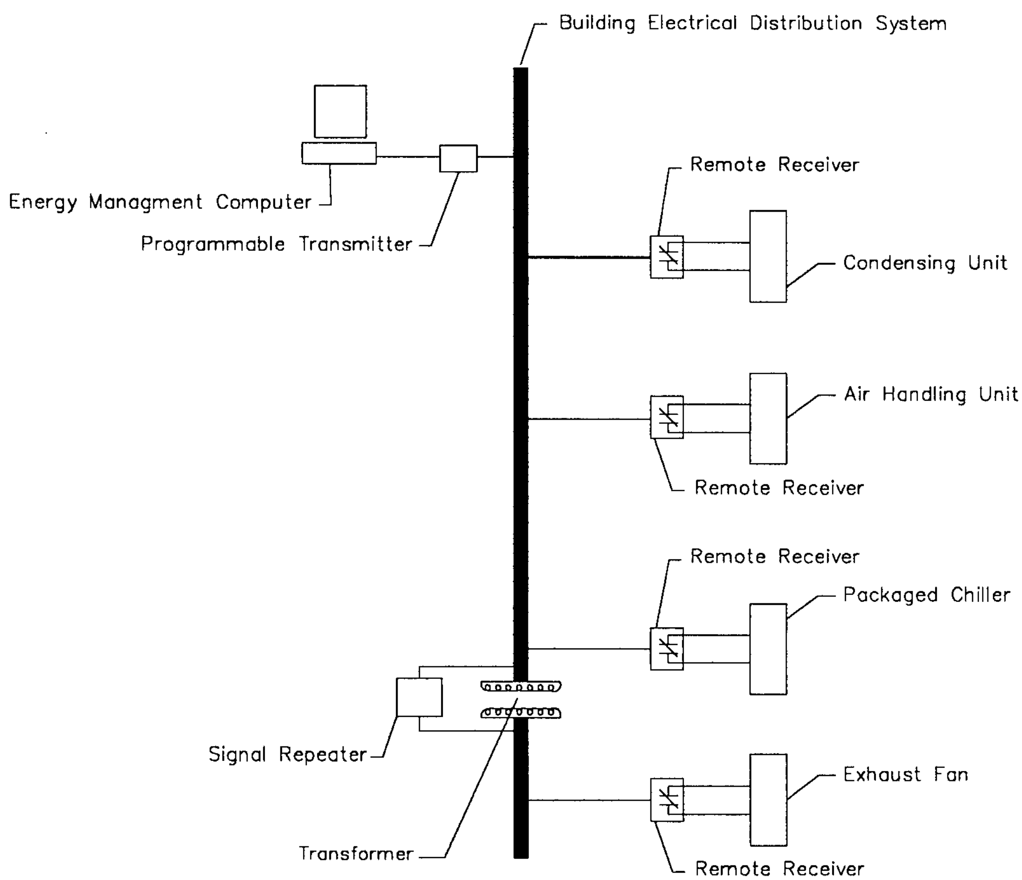
Power Line Carrier (PLC) EMS Systems

The PLC type control system is one in which the communication between components of the system takes place over the buildings electrical distribution wiring. This system utilizes a transmitter or encoder to generate a high frequency signal which is transmitted through the building wiring where it is received by the appropriate receiver and used to turn equipment on or off. The controller which initiates the control signals can be interfaced with a computerized energy management program which can provide time scheduling and demand limiting based on several parameters, including time of day, ambient temperatures and electric demand levels. These input parameters can only received from within the building being controlled. The typical PLC controller is not capable of communicating over a wide area network with other systems or centralized power monitoring equipment. Access is limited to "dial-up" modem communication with other controllers of similar configuration. Equipment can be controlled on an individual basis, or by electrical circuit if several units are connected to the same branch circuit or panel board. These systems can also be used to control lighting. The flexibility of this system depends greatly upon the configuration and condition of the existing building electrical system. For example, if all of the fan coil units for each floor of the building are served from a dedicated panel, that floor can be controlled as one zone by utilizing only one receiver relay.

The level of control that the PLC systems is capable of providing depends upon the power and sophistication of the controlling computer. There are variety of software packages available, each with different levels of control capability. Lower level systems provide on/off control based on manual inputs or simple time of day scheduling. Higher level systems can receive input information directly from demand metering equipment and through two way communication, monitor and track space conditions and equipment status.

Based on several factors including availability, competition and service support, it was decided for the purposes of this study that a computer controlled, on/off system would be evaluated. See Figure 2.3 on page II-9 for a typical system schematic. It should also be noted that this configuration represents the most popular usage of PLC systems in the industry today and therefore offers the best opportunity for competitive bidding. The PLC will not take the place of the existing building control system which must be maintained to provide all temperature and safety control functions.

Figure 2.3: Power Line Carrier System Schematic:



This system offers a lower level of control, monitoring, and flexibility than the DDC system.

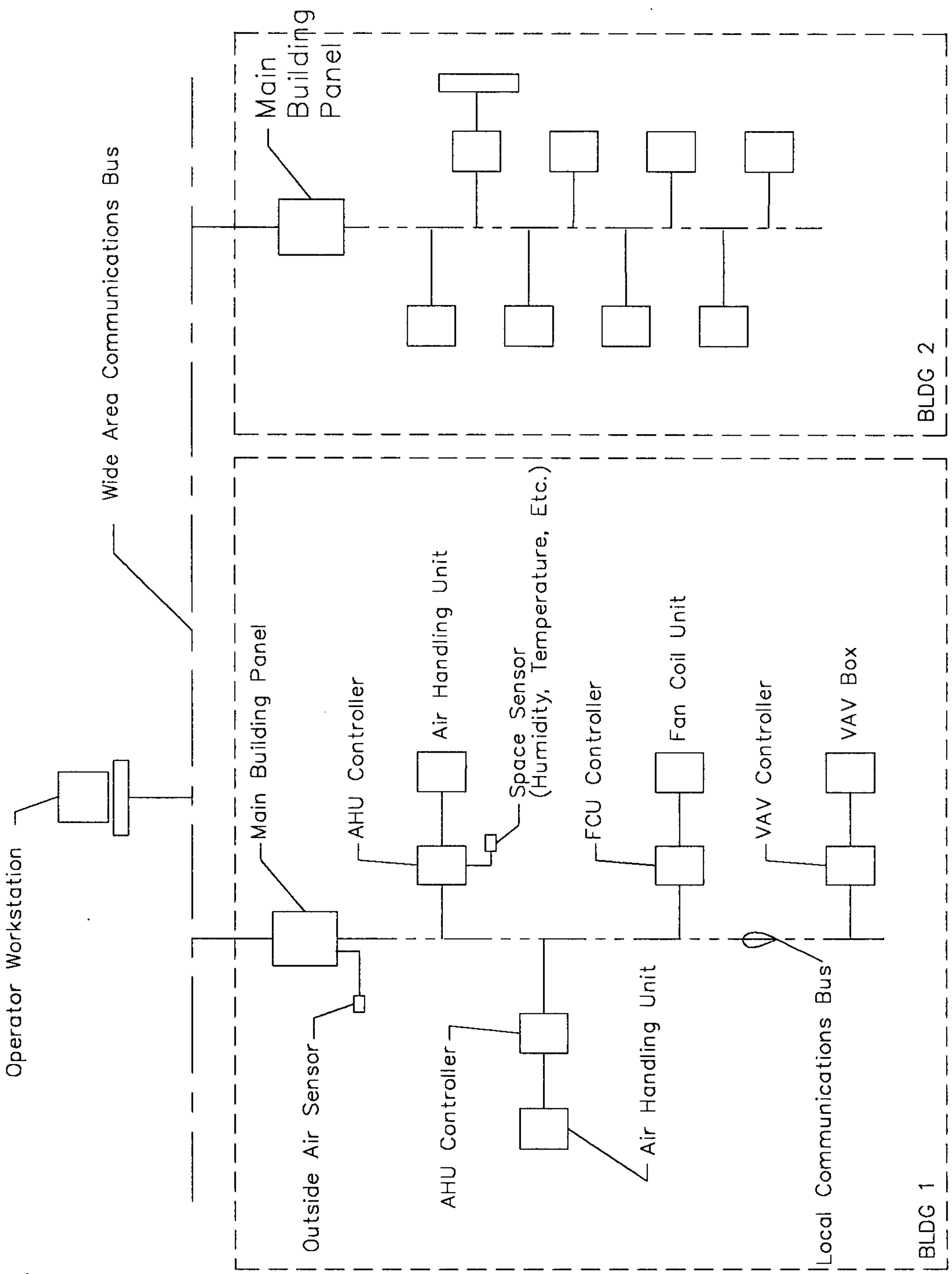
Direct Digital Control (DDC) EMS Systems

A DDC system is one that typically uses a series of stand-alone controllers which are linked together in a network arrangement by use of a local communications bus. Each controller serves an individual piece of equipment such as an air handling unit, VAV box, or fan coil unit and is programmed to perform the control function independent of the other network components. The local bus provides means to collect, store, and analyze data from the controllers using network controllers or control units. See Figure 2.4 on page II-11 for a typical system schematic. These control units can provide a variety of energy management functions such as optimal start, demand limiting, water and air temperature reset as well as trend logging functions such as run time totalization and space temperature data. The network controllers can also be interlocked with other network controllers in the same building or in other buildings using a separate communications bus. This communications bus can be used to interlock several buildings at one or more sites and provide access to all of the control system components by use of an operator workstation. From the operator workstation an operator may change the setpoints and time schedules for all of the equipment connected to the system. In addition, the operator workstation can be used to store, access and output historical data which can be used for maintenance scheduling and troubleshooting of the HVAC systems. In most systems, software is available which can be used to schedule maintenance activities based on run time, elapsed time, or other operating parameters such as dirty filters.

This system offers the highest level of control, monitoring and flexibility of all systems described in this report. It is also the system most widely used in the commercial building market today. The DDC system offers the advantage of "Add-On" capabilities which allows a basic system to be continually upgraded as funding or operational requirements dictate. Because the system uses a series of twisted pair communications busses, additional points can typically be added with only a minimum of new wiring.

The building control industry along with the many major HVAC equipment manufacturers and various professional organizations are currently participating in cooperative efforts to form open protocol standards for direct digital controls in building systems. While the goal of compatibility between competing brands of control systems is not expected for the next 5 to 10 years, this effort has already resulted in a number of agreements which allow building control systems to interface with DDC components in major mechanical and electrical equipment. There are also companies which offer interface software to allow different brands of systems to be monitored and controlled with a single PC workstation.

Figure 2.4: DDC System Schematic



III. BUILDING ANALYSIS

A. BUILDING 200 - ENLISTED MEN'S SERVICE CLUB

Existing System Description

The existing mechanical system for this building consists of six constant volume, central station air handling units, one water chiller with two remote air cooled condensing units, one boiler, five pumps and several exhaust fans as well as cabinet unit heaters in each of two entrance vestibules and hot water fin-tube radiation at various areas on the perimeter of the building.

Five of the six air handling units have both hot water heating and chilled water cooling coils with three-way pneumatic control valves and are served by a remote return air fan. All five are equipped with pneumatically operated supply, return and relief dampers which are controlled by a remote mounted manually adjustable position control. The units are not equipped with economizer controls to allow for use of outside air for cooling during periods of mild weather. Two of these air handlers are multi-zone units with pneumatic zone dampers while the three are single zone units. The sixth air handling unit is heating and ventilating unit with a hot water heating coil and is ducted for 100% outside air with no return air capabilities. This unit (AHU-6) was originally designed to serve a kitchen facility which has been reduced to a small food preparation area with one small exhaust hood a small dish washing area with an exhaust hood while the remaining area has been converted to a travel office.

The chiller provides the cooling water for the entire building with a primary chilled water pump circulating the chilled water to the five cooling/heating air handling units. Each condensing unit serves a single refrigerant circuit with-in the chiller and is controlled by a thermostat which senses chilled water supply temperature. The chiller operates using refrigerant R-22.

Hot water for heating is provided by an oil fired boiler operating on a hot water reset schedule which adjusts the supply temperature based on the outside air temperature. The pumps which circulate the chilled and hot water are controlled through motor starters which are equipped with Hand-On-Automatic (HOA) switches.

Analysis of EMS Options

DEMAND SAVINGS: The savings attributable to a demand limiting strategy as described in Example 2.1 for this building would be calculated as follows:

2 - 60 Ton Air Cooled Chillers

1 Compressor @ 211 Amps, 200 Volts, 3 Phase
$211 \times 200 \times \sqrt{3}$
= 73093 Volt-Amps (VA) per chiller

6 Fan Motors @ 1.5 Horsepower (10 Amps, 230 Volts, 1 Phase)

6 x 10 x 230
= 13800 VA per chiller

73093 VA + 13800 VA
= 86893 VA per chiller

86893 VA x 0.65 (Average Power Factor)
= 56480 Watts/Chiller

56480 Watts/Chiller x 2 Chillers x 1kW/1000 Watts
= 113 kW

= 113 kW x $12.54/kW demand charge/month
= $1417/month x 12 months/year
= $16999/year / 10 buildings
= $1700/year

ECO #1 FMR: The FMR system can be utilized to limit the electric demand from this building in accordance with Example 2.1. The system would consist of one receiver/relay installed on each of two condensing units (ACCU-1 and ACCU-2) to cycle the units off in accordance with the demand strategy.

The system as described above will require an initial investment of approximately $1115 and result in an estimated savings of $14,909 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 13.37 and a payback period of 1 year.

ECO #2 PLC: The PLC system which was evaluated for this building includes start/stop control of the air handling units, chillers and pumps. PLC relays would be interlocked with the motor starters on supply and return fans of each air handling unit, as well as the motor starters for each pump and to the remote start/stop contacts (if present) on the air cooled condensing units of the chiller. A stand-alone transceiver would be installed to control each relay and provide communication with a remote PC workstation through a modem connection. The transceiver would be capable of providing time of day scheduling for all connected equipment based on a pre-set adjustable schedule. The following is a list of control points for this system:

PLC POINTS LIST

Building - 200

Point Description	Motor Starter Interlock	Unit Control Circuit Interlock	Unit Power Circuit Interlock
Air Handling Units (Typ. of 5)			
Supply Fan Start/Stop	X		
Return Fan Start/Stop	X		
Outside Air Damper Open/Close		X	
Air Handling Units (100% outside air)			
Supply Fan Start/Stop	X		
Outside Air Damper Open/Close		X	
Split Air Cooled Chiller			
Condensing Unit Enable/Disable (Typ. of 2)		X	
Chilled Water Pump Start/Stop	X		
Boiler			
Burner Enable/Disable			X
Hot Water Pump Start/Stop	X		
Standby Pump Start/Stop	X		
Radiant Heating Pump Start/Stop	X		

The system as described above will require an initial investment of approximately $12,711 and result in an estimated savings of $59,601 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 4.69 and a payback period of 3 years.

ECO #3 DDC: This system would include stand-alone controllers for each air handling unit, boiler and chiller, which are capable of time of day scheduling, night setback and historical data logging. In addition the controller for the boiler will be capable of resetting the hot water supply temperature based on the outside air temperature. Each controller would be tied to a stand-alone building control panel which is capable of demand limiting and optimum start functions as well "dial-up access from a remote PC workstation or communication through an Installation-wide fiber optic system with other buildings and PC work station. The following is a list of control points for this system:

DDC POINTS LIST

Building - 200

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
Single Zone Air Handling Units (Typ. of 3)				
Mixed Air Enthalpy		X		
Return Air Enthalpy		X		
Outside Air Enthalpy		X		
Outside Air Damper				X
Return Air Damper				X
Relief Air Damper				X
Supply Fan Start/Stop			X	
Return Fan Start/Stop			X	
Supply Fan Status	X			
Return Fan Status	X			
Hot Water Valve				X
Chilled Water Valve				X
Supply Air Temperature		X		
Space Temperature		X		
Multi-zone Air Handling Units (Typ. of 2)				
Same as above				
Zone Dampers				X
Hot Deck Supply Temperature		X		
Cold Deck Supply Temperature		X		
Single Zone - 100% Outside Air (AHU-6)				
Outside Air Temperature		X		
Supply Fan Start/Stop			X	
Supply Fan Status	X			
Hot Water Valve				x
Hot Water Circulator Start/Stop			X	
Hot Water Circulator Status	X			
Discharge Air Temperature		X		
Outside Air Damper				X
Bypass Damper				X
Hot water Coil Discharge Temperature		X		
Chiller				
Chilled Water Return Temperature		X		
Chilled Water Supply Temperature		X		

Point Description		Binary Input	Analog Input	Binary Output	Analog Output
Condensing Unit Start/Stop	(Typ. of 2)			X	
Condensing Unit Status	(Typ. of 2)	X			
Chilled Water Pump Start/Stop				X	
Chilled Water Pump Status		X			
Boiler					
Burner Start/Stop				X	
Burner Status		X			
Hot Water Return Temperature			X		
Hot Water Supply Temperature			X		
Hot Water Pump Start/Stop				X	
Hot Water Pump Status		X			
Standby Pump Start/Stop				X	
Standby Pump Status		X			
Radiant Heating Pump Start/Stop				X	
Radiant Heating Pump Status		X			

The system as described above will require an initial investment of approximately $78,764 and result in an estimated savings of $152,246 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 1.93 and a payback period of 5 years.

The following pages include the building simulation calculation and life cycle cost analysis results for the baseline conditions as well as each ECO.

Building Simulation Results - Baseline Condition and ECO #1

ANNUAL ENERGY COSTS

Building: Building 200 - Baseline 08-15-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	291599 kWh	5739	0.219	18.3 %
Natural Gas	28480 Therm	17313	0.659	55.2 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0 1000 lb	0	0.000	0.0 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		23052	0.878	73.5 %
Electric	421743 kWh	8300	0.316	25.1 %
Natural Gas	0 Therm	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0 1000 lb	0	0.000	0.0 %
>>> Non-HVAC Subtotal		8300	0.316	26.5 %
>>> GRAND TOTAL		31351	1.194	100.0 %

* Cost per unit floor area is based on the gross building floor area.
  Gross floor area................: 26256 sqft
  Conditioned floor area..........: 21402 sqft

Building Simulation Results - ECO #2

ANNUAL ENERGY COSTS

Building: Building 200 - PLC 08-15-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	233536 kWh	4596	0.175	17.9 %
Natural Gas	21115 Therm	12836	0.489	49.9 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0 1000 lb	0	0.000	0.0 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		17432	0.664	67.7 %
Electric	421743 kWh	8300	0.316	32.3 %
Natural Gas	0 Therm	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0 1000 lb	0	0.000	0.0 %
>>> Non-HVAC Subtotal		8300	0.316	32.3 %
>>> GRAND TOTAL		25732	0.980	100.0 %

* Cost per unit floor area is based on the gross building floor area.
  Gross floor area...............: 26256 sqft
  Conditioned floor area.........: 21402 sqft

Building Simulation Results - ECO #3

ANNUAL ENERGY COSTS

Building: Building 200 - DDC 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	206634 kWh	4067	0.155	17.3 %
Natural Gas	18411 Therm	11192	0.426	47.5 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0 1000 lb	0	0.000	0.0 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		15259	0.581	64.8 %
Electric	421743 kWh	8300	0.316	35.2 %
Natural Gas	0 Therm	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0 1000 lb	0	0.000	0.0 %
>>> Non-HVAC Subtotal		8300	0.316	35.2 %
>>> GRAND TOTAL		23559	0.897	100.0 %

* Cost per unit floor area is based on the gross building floor area.
  Gross floor area...............: 26256 sqft
  Conditioned floor area.........: 21402 sqft

Life Cycle Cost Analysis - ECO #1 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG200-BASE
ALTERNATIVE: BLDG200-FMR

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 200-BASE.LCC
ALTERNATIVE LCC FILE: 200-FMR.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG200-BASE	ALTERNATIVE: BLDG200-FMR	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$1,115	-$1,115
SUBTOTAL	$0	$1,115	-$1,115
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$72,096	$72,096	$0
ENERGY-RELATED COSTS	$331,719	$316,810	$14,909
SUBTOTAL	$403,814	$388,906	$14,909
TOTAL P.V. LIFE-CYCLE COST	$403,814	$390,021	$13,794

NET SAVINGS FROM ALTERNATIVE BLDG200-FMR COMPARED TO ALTERNATIVE BLDG200-BASE

Net Savings	=	P.V. of non-investment savings	$14,909
	-	Increased total investment	$1,115
		Net Savings:	$13,794

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG200-FMR COMPARED TO ALTERNATIVE BLDG200-BASE

$$\text{SIR} = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 13.37$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG200-FMR COMPARED TO ALTERNATIVE BLDG200-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 33.62%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 1
Discounted Payback occurs in year 1

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Annual Consumption Alternative	Annual Consumption Savings	Life-Cycle Savings
Electricity	kWh	727,922	727,922	0	0
Natural Gas	Therm	29,904	29,904	0	0

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Annual Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO2 (Mg):	422.8	422.8	0.0	0.0
SOx (Kg):	3,552.7	3,552.7	0.0	0.0
NOx (Kg):	1,813.6	1,813.6	0.0	0.0
Natural Gas:				
CO2 (Mg):	157.9	157.9	0.0	0.0
SOx (Kg):	0.9	0.9	0.0	0.0
NOx (Kg):	119.6	119.6	0.0	0.0
Total:				
CO2 (Mg):	580.8	580.8	0.0	0.0
SOx (Kg):	3,553.6	3,553.6	0.0	0.0
NOx (Kg):	1,933.2	1,933.2	0.0	0.0

Life Cycle Cost Analysis - ECO #2 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG200-BASE
ALTERNATIVE: BLDG200-PLC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 200-BASE.LCC
ALTERNATIVE LCC FILE: 200-PLC.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG200-BASE	ALTERNATIVE: BLDG200-PLC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$12,711	-$12,711
SUBTOTAL	$0	$12,711	-$12,711
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$72,096	$72,096	$0
ENERGY-RELATED COSTS	$331,719	$272,118	$59,601
SUBTOTAL	$403,814	$344,214	$59,601
TOTAL P.V. LIFE-CYCLE COST	$403,814	$356,925	$46,890

NET SAVINGS FROM ALTERNATIVE BLDG200-PLC COMPARED TO ALTERNATIVE BLDG200-BASE

Net Savings	=	P.V. of non-investment savings	$59,601
	-	Increased total investment	$12,711
		Net Savings:	$46,890

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG200-PLC COMPARED TO ALTERNATIVE BLDG200-BASE

$$\text{SIR} = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 4.69$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG200-PLC COMPARED TO ALTERNATIVE BLDG200-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 20.33%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 3
Discounted Payback occurs in year 3

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Annual Consumption Alternative	Annual Consumption Savings	Life-Cycle Savings
Electricity	kWh	727,922	666,966	60,956	609,560
Natural Gas	Therm	29,904	22,171	7,733	77,330

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Annual Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO_2 (Mg):	422.8	387.4	35.4	354.1
SOx (Kg):	3,552.7	3,255.2	297.5	1,856.4
NOx (Kg):	1,813.6	1,661.7	151.9	1,518.7
Natural Gas:				
CO_2 (Mg):	157.9	117.1	40.8	408.4
SOx (Kg):	0.9	0.7	0.2	0.0
NOx (Kg):	119.6	88.7	30.9	309.3
Total:				
CO_2 (Mg):	580.8	504.5	76.2	762.5
SOx (Kg):	3,553.6	3,255.8	297.7	1,856.4
NOx (Kg):	1,933.2	1,750.4	182.8	1,828.0

Life Cycle Cost Analysis - ECO #3 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG200-BASE
ALTERNATIVE: BLDG200-DDC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 200-BASE.LCC
ALTERNATIVE LCC FILE: 200-DDC.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG200-BASE	ALTERNATIVE: BLDG200-DDC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$78,764	-$78,764
SUBTOTAL	$0	$78,764	-$78,764
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$72,096	$24,909	$47,187
ENERGY-RELATED COSTS	$331,719	$226,660	$105,059
SUBTOTAL	$403,814	$251,569	$152,246
TOTAL P.V. LIFE-CYCLE COST	$403,814	$330,333	$73,482

NET SAVINGS FROM ALTERNATIVE BLDG200-DDC COMPARED TO ALTERNATIVE BLDG200-BASE

Net Savings	=	P.V. of non-investment savings	$152,246
	-	Increased total investment	$78,764
		Net Savings:	$73,482

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG200-DDC COMPARED TO ALTERNATIVE BLDG200-BASE

$$\text{SIR} = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 1.93$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG200-DDC COMPARED TO ALTERNATIVE BLDG200-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 10.12%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 5
Discounted Payback occurs in year 6

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Annual Consumption Alternative	Annual Consumption Savings	Life-Cycle Savings
Electricity	kWh	727,922	628,377	99,545	995,450
Natural Gas	Therm	29,904	18,411	11,493	114,930

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Annual Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO2 (Mg):	422.8	365.0	57.8	578.2
SOx (Kg):	3,552.7	3,066.8	485.8	3,031.6
NOx (Kg):	1,813.6	1,565.6	248.0	2,480.1
Natural Gas:				
CO2 (Mg):	157.9	97.2	60.7	606.9
SOx (Kg):	0.9	0.6	0.3	0.0
NOx (Kg):	119.6	73.6	46.0	459.7
Total:				
CO2 (Mg):	580.8	462.2	118.5	1,185.2
SOx (Kg):	3,553.6	3,067.4	486.2	3,031.6
NOx (Kg):	1,933.2	1,639.2	294.0	2,939.8

Recommendations

Energy Management System Evaluation Matrix

FUNCTION	PLC	DDC
Hot Water Reset	0	1
Supply Air Reset	0	1
Chilled Water Reset	0	1
Enthalpy Economizer	0	2
Time of Day Scheduling	10	10
Demand Limiting (Installation Wide)	0	2
Centralized Control	0	2
Centralized Monitoring	0	2
Expandability	1	2
Flexibility	1	2
Maintenance Scheduling	0	2
Optimum Start	1	2
Occupant Control/Override	1	1
Comfort Control	0	2
Reliability/Maintainability	1	2
Effect on Equipment Life	0	2
Maintenance Costs	0	2
Savings to Investment Ration (SIR)	10	5
Total	25	43

The evaluation matrix above is intended to provide an objective comparison of two systems with widely varying capabilities. This matrix assigns relative value to the factors which were identified as being important in evaluating an EMS. From the results of this evaluation matrix the merits of the DDC system surpass those of the PLC system for this Building. Although the savings to investment ratio of the FMS and PLC systems exceed that of the DDC system, the over-all energy savings and total merits of the DDC system surpass those of the other two systems for this building. The DDC system offers the greatest benefit for this building with respect to total Installation wide energy savings and HVAC system operation and maintenance.

The life cycle cost analyses indicated that all three of the systems meet the ECIP criteria.

On the basis of the greatest Installation-wide energy savings and HVAC operation and maintenance this building should be considered for a DDC EMS installation as described above.

B. BUILDING 219 - FINANCE OFFICE BUILDING

Existing System Description

The mechanical system in this building consists of two air handling units, numerous fan-coil units, two air cooled chillers, two pumps, two boilers, and several exhaust fans.

One air handling unit (AHU-1) which conditions the interior of the office areas of the building and provides ventilation air for the perimeter office areas is a central station type unit with a combination hot water/chilled water coil in a 2-pipe arrangement utilizing a two-way pneumatic control valve. Air handling unit (AHU-1A) serves the auditorium portion of the building and is a field built-up type unit with a supply fan, combination hot water/chilled water coil with a two-way control valve, and an electric resistance duct heater. This unit is equipped with an economizer control to utilize outside air for cooling during periods of mild weather and a humidity control to modulate the chilled water valve and electric duct heater to maintain the relative humidity level below 50%. The perimeter office portion of the building is served by 2-pipe fan coil units which are equipped with manual fan speed controls and thermostatically controlled electric two-way hot/chilled water valves.

One chiller (C-1) is a reciprocating type with two compressors and a two-circuit remote air cooled condenser. The other chiller (C-1A) is a packaged air cooled reciprocating type which is located outside of the building. This chiller serves the auditorium portion of the building. The compressors are cycled and staged to maintain a set chilled water supply temperature. Both chillers utilize refrigerant R-22.

Heating water for the building is provided by two parallel oil fired steam boilers through separate heat exchangers which serve both the auditorium and office portion of the building.

One steam condensate unit with a receiver and dual pumps provides the means for condensate return to the boilers. One chilled water/hot water pumps serve each of the two portions of the building circulating chilled water for summer cooling and hot water for winter heating.

Analysis of EMS options

DEMAND SAVINGS: The savings attributable to a demand limiting strategy as described in Example 2.1 for this building would be calculated as follows:

1 - 60 Ton Air Cooled Chiller

2 Compressors @ 55 Amps, 460 Volt, 3 Phase
$2 \times 55 \times 460 \times \sqrt{3}$
= 87642 VA

2 Fan Motors @ 11.0 Amps, 460 Volt, 3 Phase
$2 \times 11.0 \times 460 \times \sqrt{3}$
= 17528 VA

1 - 40 Ton Air Cooled Chiller

2 Compressors @ 40 Amps, 460 Volt, 3 Phase
$2 \times 40 \times 460 \times \sqrt{3}$
= 63739 VA

4 Fan Motors @ 1.8 Amps, 460 Volt, 3 Phase
$4 \times 1.8 \times 460 \times \sqrt{3}$
= 5737 VA

87642 VA + 17528 VA + 63739 VA + 5737 VA
= 174646 VA

174646 VA x 0.65 (Average Power Factor) x 1 kW/1000 Watts
= 113.5 kW

113.5 kW x $12.54/kW demand charge/month
= $1423/month x 12 months/year
= $17076/year / 10 buildings
= <u>$1708/year</u>

This demand savings estimate applies to both the FMR (ECO #1) and DDC (ECO #3) systems for this building.

ECO #1 FMR: The FMR system can be utilized to limit the electric demand from this building in accordance with Example 2.1 to result in the savings as calculated above. The system would consist of one receiver/relay installed on each of two air cooled chillers (C-1 and C-1A) and one receiver/relay on the air cooled condenser (ACC-1) to cycle the units off in accordance with the demand strategy.

The system as described above will require an initial investment of approximately $1,673 and result in an estimated savings of $14,979 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 8.95 and a payback period of 1 year.

ECO #2 PLC: The PLC system selected for this building includes a PLC relay to control each air handling unit, pump and air cooled chiller as well as a relay for each electrical branch circuit feeding the fan coil units. A stand-alone transceiver would be installed to control each relay and provide communication with a remote PC workstation through a modem connection. The transceiver would be capable of providing time of day scheduling for all connected equipment based on a pre-set adjustable schedule. The following is a control points list for this system:

PLC POINTS LIST

Building - 219

Point Description	**Motor Starter Interlock**	**Unit Control Circuit Interlock**	**Unit Power Circuit Interlock**
AHU-1 A (Auditorium)			
Supply Fan Start/Stop	X		
Outside Air Damper Open/Close		X	
AHU-1 B (Finance and Accounting)			
Supply Fan Start/Stop	X		
Return Fan Start/Stop	X		
Outside Air Damper Open/Close		X	
Fan Coil Units (Typ. of 38)			
Fan Start/Stop	X		
Boilers (Typ. of 2)			
Burner Enable/Disable			X
Packaged Air Cooled Chiller			
Chiller Enable/Disable		X	
Split Air Cooled Chiller			
Condenser Fans Enable/Disable		X	
Compressor Enable/Disable (Typ. of 2)		X	
Dual Temperature Water Pumps (Typ. of 2)			
Pump Start/Stop	X		

The system as described above will require an initial investment of approximately $12,516 to install and will result in an estimated savings of $91,836 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 7.34 and a payback period of 2 years.

ECO #3 DDC: This system includes a stand-alone controller for each air handling unit, air cooled chiller, and boiler as well as groups of 8 fan coil units. Each controller will be connected to a stand-alone building control panel through a communication bus. Each stand-alone controller will be capable of time of day scheduling, night setback and historic data logging while the building control panel is capable of providing demand limiting and optimum start for each piece of controlled equipment. In addition the controller for the boiler will be capable of resetting the hot water supply temperature based on the outside air temperature. The control panel will also allow for "dial-up access from a remote PC workstation or communication through an Installation-wide fiber optic system with other buildings and PC work station. The following is a control points list for this system:

DDC POINTS LIST

Building - 219

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
AHU-1 (Finance and Accounting)				
Mixed Air Enthalpy		X		
Return Air Enthalpy		X		
Outside Air Enthalpy		X		
Outside Air Damper				X
Return Air Damper				X
Relief Air Damper				X
Supply Fan Start/Stop			X	
Return Fan Start/Stop			X	
Supply Fan Status	X			
Return Fan Status	X			
Dual Temperature Valve				X
Discharge Air Temperature		X		
Space Temperature		X		

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
AHU-1 A (Auditorium)				
Outside Air Enthalpy		X		
Return Air Enthalpy		X		
Mixed Air Enthalpy		X		
Outside Air Damper				X
Return Air Damper				X
Relief Air Damper				X
Supply Fan Start/Stop			X	
Supply Fan Status	X			
Dual Temperature Valve				X
Discharge Air Temperature		X		
Discharge Relative Humidity		X		
Reheat Step Control				X
Space Temperature		X		
Space Humidity		X		
Fan Coil Units (Typ. of 38)				
Fan Start/Stop			X	
Zone Temperature		X		
Boilers (Typ. of 2)				
Burner Start/Stop			X	
Burner Status	X			
Steam Discharge Pressure		X		
Condensate Return Temperature		X		
Hot Water Converter (Typ. of 2)				
Supply Steam Pressure		X		
Condensate Return Temperature		X		
Hot Water Return Temperature		X		
Hot Water Supply Temperature		X		
Steam Valve				X
Packaged Chiller				
Chilled Water Return Temperature		X		
Chilled Water Supply Temperature		X		
Chiller Start/Stop			X	
Chiller Status	X			

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
Split Air Cooled Chiller				
Chilled Water Supply Temperature		X		
Chilled Water Return Temperature		X		
Compressor Start/Stop			X	
Compressor Status	X			
Dual Temperature Water Loop (Typ. of 2)				
Dual Temperature Pump Start/Stop			X	
Dual Temperature Status	X			
DTW Supply Temperature		X		
DTW Return Temperature		X		
DTW Changeover Valve			X	

The system as described above will require an initial investment of $72,141 and result in an estimated savings of $146,518 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 2.03 and a payback period of 5 years.

The following pages include the building simulation calculation and life cycle cost analysis results for the baseline conditions as well as each ECO.

Building Simulation Results - Baseline Condition and ECO #1

ANNUAL ENERGY COSTS

Building: Building 219 - Baseline 01-04-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	388008 kWh	7636	0.232	23.9 %
Natural Gas	23850 Therm	14499	0.440	45.5 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0	0	0.000	0.0 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		22135	0.672	69.4 %
Electric	496200 kWh	9765	0.296	30.6 %
Natural Gas	0 Therm	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0	0	0.000	0.0 %
>>> Non-HVAC Subtotal		9765	0.296	30.6 %
>>> GRAND TOTAL		31900	0.969	100.0 %

* Cost per unit floor area is based on the gross building floor area.
Gross floor area...............: 32937 sqft
Conditioned floor area..........: 32937 sqft

Building Simulation Results - ECO #2

ANNUAL ENERGY COSTS

Building: Building 219 - PLC 01-04-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	190811 kWh	3755	0.114	16.4 %
Natural Gas	15490 Therm	9417	0.286	41.1 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0	0	0.000	0.0 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		13172	0.400	57.4 %
Electric	496200 kWh	9765	0.296	42.6 %
Natural Gas	0 Therm	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0	0	0.000	0.0 %
>>> Non-HVAC Subtotal		9765	0.296	42.6 %
>>> GRAND TOTAL		22937	0.696	100.0 %

* Cost per unit floor area is based on the gross building floor area.
Gross floor area...............: 32937 sqft
Conditioned floor area..........: 32937 sqft

Building Simulation Results - ECO #3

ANNUAL ENERGY COSTS

Building: Building 219 - DDC 01-04-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	181447 kWh	3571	0.108	15.7 %
Natural Gas	15490 Therm	9417	0.286	41.4 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0	0	0.000	0.0 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		12987	0.394	57.1 %
Electric	496200 kWh	9765	0.296	42.9 %
Natural Gas	0 Therm	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0	0	0.000	0.0 %
>>> Non-HVAC Subtotal		9765	0.296	42.9 %
>>> GRAND TOTAL		22753	0.691	100.0 %

* Cost per unit floor area is based on the gross building floor area.
  Gross floor area................: 32937 sqft
  Conditioned floor area..........: 32937 sqft

Life Cycle Cost Analysis - ECO #1 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG219-BASE
ALTERNATIVE: BLDG219-FMR

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 219-BASE.LCC
ALTERNATIVE LCC FILE: 219-FMR.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG219-BASE	ALTERNATIVE: BLDG219-FMR	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$1,673	-$1,673
SUBTOTAL	$0	$1,673	-$1,673
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$51,685	$51,685	$0
ENERGY-RELATED COSTS	$331,859	$316,880	$14,979
SUBTOTAL	$383,544	$368,565	$14,979
TOTAL P.V. LIFE-CYCLE COST	$383,544	$370,238	$13,306

NET SAVINGS FROM ALTERNATIVE BLDG219-FMR COMPARED TO ALTERNATIVE BLDG219-BASE

Net Savings	=	P.V. of non-investment savings	$14,979
	-	Increased total investment	$1,673
		Net Savings:	$13,306

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG219-FMR COMPARED TO ALTERNATIVE BLDG219-BASE

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 8.95$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG219-FMR COMPARED TO ALTERNATIVE BLDG219-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 28.37%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 1
Discounted Payback occurs in year 2

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Alternative	Savings	Life-Cycle Savings
Electricity	kWh	903,608	903,608	0	0
Natural Gas	Therm	25,043	25,043	0	0

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO_2 (Mg):	524.9	524.9	0.0	0.0
SOx (Kg):	4,410.1	4,410.1	0.0	0.0
NOx (Kg):	2,251.3	2,251.3	0.0	0.0
Natural Gas:				
CO_2 (Mg):	132.3	132.3	0.0	0.0
SOx (Kg):	0.8	0.8	0.0	0.0
NOx (Kg):	100.2	100.2	0.0	0.0
Total:				
CO_2 (Mg):	657.1	657.1	0.0	0.0
SOx (Kg):	4,410.9	4,410.9	0.0	0.0
NOx (Kg):	2,351.5	2,351.5	0.0	0.0

Life Cycle Cost Analysis - ECO #2 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG219-BASE
ALTERNATIVE: BLDG219-PLC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 219-BASE.LCC
ALTERNATIVE LCC FILE: 219-PLC.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG219-BASE	ALTERNATIVE: BLDG219-PLC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$12,516	-$12,516
SUBTOTAL	$0	$12,516	-$12,516
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$51,685	$51,685	$0
ENERGY-RELATED COSTS	$331,859	$240,024	$91,836
SUBTOTAL	$383,544	$291,709	$91,836
TOTAL P.V. LIFE-CYCLE COST	$383,544	$304,225	$79,320

NET SAVINGS FROM ALTERNATIVE BLDG219-PLC COMPARED TO ALTERNATIVE BLDG219-BASE

Net Savings	=	P.V. of non-investment savings	$91,836
	-	Increased total investment	$12,516
		Net Savings:	$79,320

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG219-PLC COMPARED TO ALTERNATIVE BLDG219-BASE

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 7.34$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG219-PLC COMPARED TO ALTERNATIVE BLDG219-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 25.84%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 2
Discounted Payback occurs in year 2

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Annual Consumption Alternative	Annual Consumption Savings	Life-Cycle Savings
Electricity	kWh	903,608	696,551	207,057	2,070,570
Natural Gas	Therm	25,043	16,265	8,778	87,780

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Annual Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO2 (Mg):	524.9	404.6	120.3	1,202.8
SOx (Kg):	4,410.1	3,399.5	1,010.6	6,305.8
NOx (Kg):	2,251.3	1,735.4	515.9	5,158.8
Natural Gas:				
CO2 (Mg):	132.3	85.9	46.4	463.6
SOx (Kg):	0.8	0.5	0.3	0.0
NOx (Kg):	100.2	65.1	35.1	351.1
Total:				
CO2 (Mg):	657.1	490.5	166.6	1,666.3
SOx (Kg):	4,410.9	3,400.0	1,010.8	6,305.8
NOx (Kg):	2,351.5	1,800.5	551.0	5,509.9

Life Cycle Cost Analysis - ECO #3 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG219-BASE
ALTERNATIVE: BLDG219-DDC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 219-BASE.LCC
ALTERNATIVE LCC FILE: 219-DDC.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG219-BASE	ALTERNATIVE: BLDG219-DDC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$72,141	-$72,141
SUBTOTAL	$0	$72,141	-$72,141
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$51,685	$20,199	$31,486
ENERGY-RELATED COSTS	$331,859	$216,827	$115,032
SUBTOTAL	$383,544	$237,026	$146,518
TOTAL P.V. LIFE-CYCLE COST	$383,544	$309,167	$74,377

NET SAVINGS FROM ALTERNATIVE BLDG219-DDC COMPARED TO ALTERNATIVE BLDG219-BASE

Net Savings =	P.V. of non-investment savings	$146,518
-	Increased total investment	$72,141
	Net Savings:	$74,377

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG219-DDC COMPARED TO ALTERNATIVE BLDG219-BASE

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 2.03$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG219-DDC COMPARED TO ALTERNATIVE BLDG219-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 10.67%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 5
Discounted Payback occurs in year 5

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Annual Consumption Alternative	Annual Consumption Savings	Life-Cycle Savings
Electricity	kWh	903,608	677,647	225,961	2,259,610
Natural Gas	Therm	25,043	15,490	9,553	95,530

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Annual Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO_2 (Mg):	524.9	393.6	131.3	1,312.6
SOx (Kg):	4,410.1	3,307.3	1,102.8	6,881.6
NOx (Kg):	2,251.3	1,688.3	563.0	5,629.7
Natural Gas:				
CO_2 (Mg):	132.3	81.8	50.4	504.5
SOx (Kg):	0.8	0.5	0.3	0.0
NOx (Kg):	100.2	62.0	38.2	382.1
Total:				
CO_2 (Mg):	657.1	475.4	181.7	1,817.1
SOx (Kg):	4,410.9	3,307.8	1,103.1	6,881.6
NOx (Kg):	2,351.5	1,750.3	601.2	6,011.9

Recommendations

Energy Management System Evaluation Matrix

FUNCTION	PLC	DDC
Hot Water Reset	0	1
Supply Air Reset	0	1
Chilled Water Reset	0	1
Enthalpy Economizer	0	1
Time of Day Scheduling	10	10
Demand Limiting (Installation Wide)	0	2
Centralized Control	0	2
Centralized Monitoring	0	2
Expandability	1	2
Flexibility	1	2
Maintenance Scheduling	0	2
Optimum Start	1	2
Occupant Control/Override	1	1
Comfort Control	0	2
Reliability/Maintainability	1	2
Effect on Equipment Life	1	2
Maintenance Costs	1	2
Savings to Investment Ration (SIR)	10	3
Total	27	40

The evaluation matrix above is intended to provide an objective comparison of two systems with widely varying capabilities. This matrix assigns relative value to the factors which were identified as being important in evaluating an EMS. From the results of this evaluation matrix the merits of the DDC system surpass those of the PLC system for this Building. Although the savings to investment ratio of the FMS and PLC systems exceed that of the DDC system, the over-all energy savings and total merits of the DDC system surpass those of the other two systems for this building. The DDC system offers the greatest benefit for this building with respect to total Installation wide energy savings and HVAC system operation and maintenance.

The life cycle cost analyses indicated that all three of the systems meet the ECIP criteria.

On the basis of the greatest Installation-wide energy savings and HVAC system operation and maintenance this building should be considered for a DDC EMS installation as described above.

C. BUILDING 247 - HUMHPREY'S HALL

Existing System Description

The existing system consists of one chiller and an accompanying cooling tower, one large air handling unit and twenty small air handling units, numerous fan-coil units, two hot water boilers, nine pumps, and several exhaust fans.

The chiller is a water cooled centrifugal type which provides chilled water for the entire building and rejects its heat to an induced draft cooling tower which is located outside of the boiler room at grade level. The chiller utilizes refrigerant R-11 and should be considered for replacement or retrofit to address the CFC issue associated with this refrigerant.

The large air handling unit located in the penthouse mechanical room serves the auditorium which is located on the first and second floors of the building. This unit is a field built-up type unit with a combination hot water/chilled water coil which is piped in a two-pipe arrangement with a three-way pneumatic control valve. The unit is equipped with a pneumatically operated outside air damper which can be adjusted manually by use of a pneumatic pressure regulator to set the outside air percentage. The small air handling units are single zone, constant volume, central station type with separate hot water and chilled water coils which are piped in a 2-pipe arrangement, each having a separate electric three-way control valve and two-way isolation valve. These units are equipped with self contained direct digital controls which provide comfort control as well as time of day scheduling functions. These units serve the classroom and administrative office areas which are located in the various wings of the building.

The faculty offices and administrative support areas are served by console type fan coil units which are located on the perimeter walls and are piped in a 2-pipe arrangement. Each unit is equipped with a manual fan speed control and a thermostatically controlled two-way electric control valve. The areas served by these units have no apparent means of outside air for the occupants. This is a potential source of indoor air quality problems in this building.

Hot water for heating the building is generated by two hot water boilers which can utilize either oil or natural gas as a fuel source. According to Ft. Belvoir operating personnel, these boilers also provide hot water for the adjacent buildings, 268, 269 and 270.

The hot water is circulated by four base-mounted centrifugal pumps with each pump controlled thru a motor starter and a HOA control.

The chilled water is circulated by two base-mounted centrifugal pumps with each pump controlled thru a motor starter and a HOA control

The condenser water is circulated by two base-mounted centrifugal pumps with each pump controlled thru a motor starter and a HOA control

Analysis of EMS Options

DEMAND SAVINGS: The savings attributable to a demand limiting strategy as described in Example 2.1 for this building would be calculated as follows:

1 - 300 Ton Water Cooled Chiller

1 Compressor 300 Tons @ 0.68 kW/ton
300 Ton x 0.68 kW/Ton
= 204 kW

204 kW x $12.54/kW demand charge/month
= $2558/month x 12 months/year
= $30696/year / 10 buildings
= $3070/year

ECO #1 FMR: The FMR system can be utilized to limit the electric demand from this building in accordance with Example 2.1. The system would consist of one receiver/relay installed on the water cooled centrifugal chiller (C-1) to cycle the unit off in accordance with the demand strategy.

The system as described above will require an initial investment of approximately $558 and result in an estimated savings of $26,923 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 48.29 and a payback period of 1 year.

ECO #2 PLC: The PLC system considered for this building includes a PLC relay for the chiller, cooling tower, and each boiler as well as one relay for each electrical branch circuit powering a fan coil unit. It is unknown at this time exactly how many branch circuits feed the fan coil units, so it was assumed for pricing purposes that on average, one branch circuit feeds 4 fan coil units. A stand-alone transceiver would be installed to control each relay and provide communication with a remote PC workstation through a modem connection. The transceiver would be capable of providing time of day scheduling for all connected equipment based on a pre-set adjustable schedule. The following is a control points list for this system:

PLC POINTS LIST

Building - 247

Point Description	Motor Starter Interlock	Unit Control Circuit Interlock	Unit Power Circuit Interlock
Auditorium Air Handling Unit			
Supply Fan Start/Stop	X		
Outside Air Damper Open/Close		X	
Fan Coil Units (Typ. of 93)			
Fan Start/Stop	X		
Boilers (Typ. of 2)			
Burner Enable/Disable			X
Hot Water Pump Start/Stop			
Centrifugal Chiller			
Chiller Enable/Disable		X	
Chilled Water Pump Start/Stop (Typ. of 2)	X		
Condenser Water Pump Start/Stop (Typ. of 2)	X		
Cooling Tower Fan Start/Stop	X		

The system as described above will require an initial investment of approximately $14,914 and result in an estimated savings of $108,303 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 7.26 and a payback period of 2 years.

ECO #2 DDC: This system consists of one stand-alone controller for the chiller, and each boiler, and air handling unit as well as one for each 8 fan coil units. Each controller will be capable of providing time of day scheduling and night setback as well as hot water reset for the boilers and chilled water and condenser water reset for the chiller and cooling tower. A stand-alone building control panel will provide demand limiting, and optimum start control for each piece of equipment as well as serve as a communications point for all controllers in the system. The pumps for this building will be connected to the controller for the piece of equipment in which they serve. Example: The hot water heating pumps will be connected to the boiler controller while the chilled water pumps and condenser water pumps will be connected to the chiller controller. The building control panel will also allow for "dial-up" access from a remote PC workstation or communication through an Installation-wide fiber optic system with other buildings and PC work station. The following is a control points list for this system:

DDC POINTS LIST

Building - 247

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
Auditorium Air Handling Unit				
Return Air Enthalpy		X		
Outside Air Enthalpy		X		
Mixed Air Enthalpy		X		
Supply Fan Start/Stop			X	
Supply Fan Status	X			
DTW Control Valve				X
DTW Supply Temperature		X		
Outside Air Damper				X
Relief Damper				X
Return Damper				X
Discharge Air Temperature		X		
Fan Coil Units (Typ. of 93)				
Fan Start/Stop			X	
Zone Temperature		X		
Boilers (Typ. of 2)				
Burner Start/Stop			X	
Burner Status	X			
Hot Water Supply Temperature		X		
Hot Water Return Temperature		X		
Hot Water Pump Start/Stop			X	
Hot Water Pump Status	X			
Chiller				
Chilled Water Return Temperature		X		
Chilled Water Supply Temperature		X		
Chiller Start/Stop			X	
Chiller Status	X			
Chilled Water Pump Start/Stop (Typ. of 2)			X	
Chilled Water Pump Status (Typ. of 2)	X			
Condenser Water Supply Temperature		X		
Condenser Water Return Temperature		X		
Cooling Tower Fan Start/Stop			X	
Cooling Tower Fan Status	X			
Condenser Water Pump Start/Stop (Typ. of 2)			X	

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
Condenser Water Pump Status (Typ. of 2)	X			

The system as described above will require an initial investment of approximately $87,416 and result in an estimated savings of $166,883 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 1.91 and a payback period of 5 years.

The following pages include the building simulation calculation and life cycle cost analysis results for the baseline conditions as well as each ECO.

Building Simulation Results - Baseline Condition and ECO #1

ANNUAL ENERGY COSTS

Building: Building 247 - Baseline 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	592897 kWh	11668	0.079	18.6 %
Natural Gas	38163 Therm	23199	0.157	36.9 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0	0	0.000	0.0 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		34868	0.235	55.5 %
Electric	1422880 kWh	28002	0.189	44.5 %
Natural Gas	0 Therm	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0	0	0.000	0.0 %
>>> Non-HVAC Subtotal		28002	0.189	44.5 %
>>> GRAND TOTAL		62870	0.425	100.0 %

* Cost per unit floor area is based on the gross building floor area.
  Gross floor area................: 148067 sqft
  Conditioned floor area..........: 143338 sqft

Building Simulation Results - ECO #2

ANNUAL ENERGY COSTS

Building: Building 247 - PLC 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	406978 kWh	8009	0.054	15.3 %
Natural Gas	27010 Therm	16419	0.111	31.3 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0	0	0.000	0.0 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		24429	0.165	46.6 %
Electric	1422880 kWh	28002	0.189	53.4 %
Natural Gas	0 Therm	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0	0	0.000	0.0 %
>>> Non-HVAC Subtotal		28002	0.189	53.4 %
>>> GRAND TOTAL		52431	0.354	100.0 %

* Cost per unit floor area is based on the gross building floor area.
  Gross floor area................: 148067 sqft
  Conditioned floor area..........: 143338 sqft

Building Simulation Results - ECO #3

ANNUAL ENERGY COSTS

Building: Building 247 - DDC 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	404356 kWh	7958	0.054	15.2 %
Natural Gas	27079 Therm	16462	0.111	31.4 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0	0	0.000	0.0 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		24419	0.165	46.6 %
Electric	1422880 kWh	28002	0.189	53.4 %
Natural Gas	0 Therm	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0	0	0.000	0.0 %
>>> Non-HVAC Subtotal		28002	0.189	53.4 %
>>> GRAND TOTAL		52422	0.354	100.0 %

* Cost per unit floor area is based on the gross building floor area.
  Gross floor area................: 148067 sqft
  Conditioned floor area..........: 143338 sqft

Life Cycle Cost Analysis - ECO #1 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG247-BASE
ALTERNATIVE: BLDG247-FMR

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 247-BASE.LCC
ALTERNATIVE LCC FILE: 247-FMR.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG247-BASE	ALTERNATIVE: BLDG247-FMR	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$558	-$558
SUBTOTAL	$0	$558	-$558
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$125,733	$125,733	$0
ENERGY-RELATED COSTS	$639,123	$612,199	$26,923
SUBTOTAL	$764,855	$737,932	$26,923
TOTAL P.V. LIFE-CYCLE COST	$764,855	$738,489	$26,366

NET SAVINGS FROM ALTERNATIVE BLDG247-FMR COMPARED TO ALTERNATIVE BLDG247-BASE

Net Savings	=	P.V. of non-investment savings	$26,923
	-	Increased total investment	$558
		Net Savings:	$26,366

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG247-FMR COMPARED TO ALTERNATIVE BLDG247-BASE

$$\text{SIR} = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 48.29$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG247-FMR COMPARED TO ALTERNATIVE BLDG247-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 51.93%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 1
Discounted Payback occurs in year 1

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Annual Consumption Alternative	Annual Consumption Savings	Life-Cycle Savings
Electricity	kWh	2,045,422	2,045,422	0	0
Natural Gas	Therm	40,071	40,071	0	0

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Annual Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO_2 (Mg):	1,188.2	1,188.2	0.0	0.0
SOx (Kg):	9,982.8	9,982.8	0.0	0.0
NOx (Kg):	5,096.1	5,096.1	0.0	0.0
Natural Gas:				
CO_2 (Mg):	211.6	211.6	0.0	0.0
SOx (Kg):	1.2	1.2	0.0	0.0
NOx (Kg):	160.3	160.3	0.0	0.0
Total:				
CO_2 (Mg):	1,399.8	1,399.8	0.0	0.0
SOx (Kg):	9,984.0	9,984.0	0.0	0.0
NOx (Kg):	5,256.4	5,256.4	0.0	0.0

Life Cycle Cost Analysis - ECO #2 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG247-BASE
ALTERNATIVE: BLDG247-PLC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 247-BASE.LCC
ALTERNATIVE LCC FILE: 247-PLC.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG247-BASE	ALTERNATIVE: BLDG247-PLC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$14,914	-$14,914
SUBTOTAL	$0	$14,914	-$14,914
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$125,733	$125,733	$0
ENERGY-RELATED COSTS	$639,123	$530,820	$108,303
SUBTOTAL	$764,855	$656,553	$108,303
TOTAL P.V. LIFE-CYCLE COST	$764,855	$671,467	$93,389

NET SAVINGS FROM ALTERNATIVE BLDG247-PLC COMPARED TO ALTERNATIVE BLDG247-BASE

Net Savings	=	P.V. of non-investment savings	$108,303
	-	Increased total investment	$14,914
		Net Savings:	$93,389

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG247-PLC COMPARED TO ALTERNATIVE BLDG247-BASE

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 7.26$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG247-PLC COMPARED TO ALTERNATIVE BLDG247-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 25.71%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 2
Discounted Payback occurs in year 2

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Annual Consumption Alternative	Annual Consumption Savings	Life-Cycle Savings
Electricity	kWh	2,045,422	1,850,207	195,215	1,952,150
Natural Gas	Therm	40,071	28,361	11,710	117,100

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Annual Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO_2 (Mg):	1,188.2	1,074.8	113.4	1,134.0
SOx (Kg):	9,982.8	9,030.0	952.8	5,945.2
NOx (Kg):	5,096.1	4,609.7	486.4	4,863.7
Natural Gas:				
CO_2 (Mg):	211.6	149.8	61.8	618.4
SOx (Kg):	1.2	0.9	0.4	0.0
NOx (Kg):	160.3	113.4	46.8	468.4
Total:				
CO_2 (Mg):	1,399.8	1,224.5	175.2	1,752.4
SOx (Kg):	9,984.0	9,030.9	953.1	5,945.2
NOx (Kg):	5,256.4	4,723.2	533.2	5,332.1

Life Cycle Cost Analysis - ECO #3 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG247-BASE
ALTERNATIVE: BLDG247-DDC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 247-BASE.LCC
ALTERNATIVE LCC FILE: 247-DDC.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG247-BASE	ALTERNATIVE: BLDG247-DDC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$87,416	-$87,416
SUBTOTAL	$0	$87,416	-$87,416
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$125,733	$106,213	$19,520
ENERGY-RELATED COSTS	$639,123	$491,759	$147,363
SUBTOTAL	$764,855	$597,972	$166,883
TOTAL P.V. LIFE-CYCLE COST	$764,855	$685,388	$79,467

NET SAVINGS FROM ALTERNATIVE BLDG247-DDC COMPARED TO ALTERNATIVE BLDG247-BASE

Net Savings	=	P.V. of non-investment savings	$166,883
	-	Increased total investment	$87,416
		Net Savings:	$79,467

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG247-DDC COMPARED TO ALTERNATIVE BLDG247-BASE

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 1.91$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG247-DDC COMPARED TO ALTERNATIVE BLDG247-BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 9.99%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 5
Discounted Payback occurs in year 6

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Annual Consumption Alternative	Annual Consumption Savings	Life-Cycle Savings
Electricity	kWh	2,045,422	1,827,236	218,186	2,181,860
Natural Gas	Therm	40,071	27,079	12,992	129,920

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Annual Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO_2 (Mg):	1,188.2	1,061.4	126.7	1,267.4
SOx (Kg):	9,982.8	8,917.9	1,064.9	6,644.8
NOx (Kg):	5,096.1	4,552.5	543.6	5,436.0
Natural Gas:				
CO_2 (Mg):	211.6	143.0	68.6	686.1
SOx (Kg):	1.2	0.8	0.4	0.0
NOx (Kg):	160.3	108.3	52.0	519.7
Total:				
CO_2 (Mg):	1,399.8	1,204.4	195.4	1,953.5
SOx (Kg):	9,984.0	8,918.7	1,065.3	6,644.8
NOx (Kg):	5,256.4	4,660.8	595.6	5,955.7

Recommendations

Energy Management System Evaluation Matrix

FUNCTION	PLC	DDC
Hot Water Reset	0	1
Supply Air Reset	0	0
Chilled Water Reset	0	1
Enthalpy Economizer	0	0
Time of Day Scheduling	10	10
Demand Limiting (Post Wide)	0	2
Centralized Control	0	2
Centralized Monitoring	0	2
Expandability	1	2
Flexibility	1	2
Maintenance Scheduling	0	2
Optimum Start	1	2
Occupant Control/Override	1	1
Comfort Control	0	2
Reliability/Maintainability	1	2
Effect on Equipment Life	1	2
Maintenance Costs	0	2
Savings to Investment Ratio (SIR)	10	3
Total	26	38

The evaluation matrix above is intended to provide an objective comparison of two systems with widely varying capabilities. This matrix assigns relative value to the factors which were identified as being important in evaluating an EMS. From the results of this evaluation matrix the merits of the DDC system surpass those of the PLC system for this Building. Although the savings to investment ratio of the FMS and PLC systems exceed that of the DDC system, the over-all energy savings and total merits of the DDC system surpass those of the other two systems for this building. The DDC system offers the greatest benefit for this building with respect to total Installation wide energy savings and HVAC system operation and maintenance.

The life cycle cost analyses indicate that all three of the systems meet the ECIP criteria.

On the basis of the greatest Installation-wide energy savings and HVAC system operation and maintenance this building should be considered for a DDC EMS installation as described above.

D. BUILDING 1425 - GM SUPPORT BUILDING

Existing System Description

The existing building mechanical system consists of one chiller, one combination chilled water/hot water pump, numerous console fan-coil units, and several exhaust fans.

A packaged air cooled chiller provides chilled water for the entire building. This unit has self contained controls and cycles and stages its compressors to maintain a preset chilled water supply temperature. This chiller utilizes refrigerant R-22.

The entire building is served by a console type fan coil units which are equipped with combination hot/chilled water coils and are piped in a two-pipe arrangement. Each unit has a self contained control panel with a manual fan-speed control and a thermostatically controlled two-way electric control valve. Ventilation air is provided through a wall louver at each unit and is controlled by automatic damper. The building control system de-energizes the fan coil unit during the unoccupied periods of the day unless the setback is overridden manually or by the night thermostat which then switches control back to the individual fan coil unit.

Hot water for building heating is provided through a steam to hot water convertor which utilizes a remote steam source which is controlled by two pneumatically operated steam valves. The hot water supply temperature is adjusted in accordance with a hot water reset schedule which is based on the outside air temperature.

The two-pipe dual temperature piping system contains a change-over control valve which is used to change the system from cooling to heating and back again. This valve is controlled by a manual changer-over switch located in the face of the main automatic temperature control panel in the basement mechanical room. A high limit aquastat located in the dual temperature return piping prevents the change-over valve from switching to the cooling position when the water temperature is above 90 F and an additional high limit aquastat located in the chilled water return piping prevents the chiller from being energized when the chilled water return temperature is above 90 F.

Analysis of EMS Options

This building already contains an EMS which provides time of day scheduling, night setback and hot water reset. In order to provide a basis for comparison of similar buildings which are no equipped with an EMS the building was analyzed by assuming that there was no EMS present and estimating a "No EMS" condition. This No EMS condition was then compared to proposed PLC and DDC systems to determine the applicability of such a system to buildings of similar construction and system type. This analysis resulted in the following systems:

DEMAND SAVINGS: The savings attributable to a demand limiting strategy as described in Example 2.1 for this building would be calculated as follows:

1 - 40 Ton Air Cooled Chiller

3 Compressors @ 39.4 Amps, 200 Volt, 3 Phase
3 x 39.4 x 200 x $\sqrt{3}$
= 40946 VA

4 Fan Motors @ 4.1 Amps x 200 Volt, 3 Phase
4 x 4.1 x 200 x $\sqrt{3}$
= 5681 VA

40946 VA + 5681 VA
= 46627 VA

= 46627 VA x 0.65 (Average Power Factor) x 1 kW/1000 Watts
= 30.3 kW

30.3 kW x $12.54/kW demand charge/month
= $380/month x 12 months/year
= $4560/year / 10 buildings
= <u>$456/year</u>

ECO #1 FMR: The FMR system can be utilized to limit the electric demand from this building in accordance with Example 2.1. The system would consist of one receiver/relay installed on the air cooled chiller (C-1) to cycle the unit off in accordance with the demand strategy.

The system as described above will require an initial investment of approximately $558 and result in an estimated savings of $3,999 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 7.17 and a payback period of 2 years.

ECO #2 PLC: The system would consist of one PLC relay for each electrical branch connection feeding a fan coil unit, it was assumed that this would result in approximately one relay for every 4 fan coil units. The air cooled chiller would also be connected to a relay. A stand-alone transceiver would be installed to control each relay and provide communication with a remote PC workstation through a modem connection. The transceiver would be capable of providing time of day scheduling for all connected equipment based on a pre-set adjustable schedule. The following is a control points list for this system:

PLC POINTS LIST

Building - 1425

Point Description	Motor Starter Interlock	Unit Control Circuit Interlock	Unit Power Circuit Interlock
Fan Coil Units (Typ. of 52)			
Fan Start/Stop			X
Outside Air Damper Open/Close		X	
Packaged Air Cooled Chiller			
Chiller Enable/Disable		X	
Dual Temperature Water Pumps (Typ. of 2)			
Pump Start/Stop	X		

The system as described above will require an initial investment of approximately $11,518 and result in an estimated net savings of $17,893 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 1.55 and a payback period of 6 years.

ECO #3 DDC: This system would consist of one stand-alone controller each for the air cooled chiller and hot water converter and one controller for each 8 fan coil units. The stand-alone controllers would provide time of day scheduling, night setback and historical data logging capabilities as well as hot water reset control for the converter. One stand-alone building control panel would provide the communications interface between each controller and demand limiting and optimum start capabilities. The building controller will also allow for "dial-up" access from a remote PC workstation or communication through an Installation-wide fiber optic system with other buildings and PC work station The following is a control points list for this building:

DDC POINTS LIST

Building - 1425

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
Fan Coil Units (Typ. of 52)				
Fan Start/Stop				X
Outside Air Damper				X
Chiller				
Chilled Water Supply Temperature		X		
Chilled Water Return Temperature		X		
Chiller Start/Stop			X	
Chiller Status	X			
Hot Water Convertor				
Steam Supply Pressure		X		
Hot Water Supply Temperature		X		
Hot Water Return Temperature		X		
Steam Valve (Typ. of 2)				X
Dual Temperature Water Loop				
DTW Supply Temperature		X		
DTW Return Temperature		X		
DTW Pump Start/Stop (Typ. of 2)			X	
DTW Pump Status (Typ. of 2)	X			
Changeover Valve (Typ. of 2)				X

The system as described above will require an initial investment of approximately $48,993 and result in an estimated savings of $33,374 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 0.68 and there is no payback.

The following pages include the building simulation calculation and life cycle cost analysis results for the baseline conditions as well as each ECO.

Building Simulation Results - Baseline Condition and ECO #1

ANNUAL ENERGY COSTS

Building: Building 1425 - NO EMS 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	72273 kWh	1422	0.092	20.1 %
Natural Gas	0	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	242 1000 lb	1934	0.125	27.3 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		3356	0.218	47.3 %
Electric	189882 kWh	3737	0.242	52.7 %
Natural Gas	0	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0 1000 lb	0	0.000	0.0 %
>>> Non-HVAC Subtotal		3737	0.242	52.7 %
>>> GRAND TOTAL		7093	0.460	100.0 %

* Cost per unit floor area is based on the gross building floor area.
Gross floor area................: 15430 sqft
Conditioned floor area..........: 13736 sqft

Building Simulation Results - ECO #2

ANNUAL ENERGY COSTS

Building: Building 1425 - PLC 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	56679 kWh	1115	0.072	20.6 %
Natural Gas	0	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	70 1000 lb	560	0.036	10.3 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		1675	0.109	31.0 %
Electric	189882 kWh	3737	0.242	69.0 %
Natural Gas	0	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0 1000 lb	0	0.000	0.0 %
>>> Non-HVAC Subtotal		3737	0.242	69.0 %
>>> GRAND TOTAL		5412	0.351	100.0 %

* Cost per unit floor area is based on the gross building floor area.
Gross floor area................: 15430 sqft
Conditioned floor area..........: 13736 sqft

Building Simulation Results - ECO #3

ANNUAL ENERGY COSTS

Building: Building 1425 - DDC 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	56679 kWh	1115	0.072	20.6 %
Natural Gas	0	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	70 1000 lb	560	0.036	10.3 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		1675	0.109	31.0 %
Electric	189882 kWh	3737	0.242	69.0 %
Natural Gas	0	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0 1000 lb	0	0.000	0.0 %
>>> Non-HVAC Subtotal		3737	0.242	69.0 %
>>> GRAND TOTAL		5412	0.351	100.0 %

* Cost per unit floor area is based on the gross building floor area.
Gross floor area................: 15430 sqft
Conditioned floor area..........: 13736 sqft

Life Cycle Cost Analysis - ECO #1 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG1425BASE
ALTERNATIVE: BLDG1425-FMR

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 1425BASE.LCC
ALTERNATIVE LCC FILE: 1425-FMS.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG1425BASE	ALTERNATIVE: BLDG1425-FMR	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$558	-$558
SUBTOTAL	$0	$558	-$558
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$41,840	$41,840	$0
ENERGY-RELATED COSTS	$71,752	$67,753	$3,999
SUBTOTAL	$113,592	$109,593	$3,999
TOTAL P.V. LIFE-CYCLE COST	$113,592	$110,151	$3,442

NET SAVINGS FROM ALTERNATIVE BLDG1425-FMR COMPARED TO ALTERNATIVE BLDG1425BASE

Net Savings	=	P.V. of non-investment savings	$3,999
	-	Increased total investment	$558
		Net Savings:	$3,442

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG1425-FMR COMPARED TO ALTERNATIVE BLDG1425BASE

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 7.17$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG1425-FMR COMPARED TO ALTERNATIVE BLDG1425BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 25.55%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 2
Discounted Payback occurs in year 2

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Annual Consumption Alternative	Annual Consumption Savings	Life-Cycle Savings
Electricity	kWh	265,769	265,769	0	0
Central Steam	Pound	254,000	254,000	0	0

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Annual Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO_2 (Mg):	154.4	154.4	0.0	0.0
SOx (Kg):	1,297.1	1,297.1	0.0	0.0
NOx (Kg):	662.2	662.2	0.0	0.0
Central Steam:				
CO_2 (Kg):	0.0	0.0	0.0	0.0
SOx (Kg):	0.0	0.0	0.0	0.0
NOx (Kg):	0.0	0.0	0.0	0.0
Total:				
CO_2 (Mg):	154.4	154.4	0.0	0.0
SOx (Kg):	1,297.1	1,297.1	0.0	0.0
NOx (Kg):	662.2	662.2	0.0	0.0

Life Cycle Cost Analysis - ECO #2 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG1425BASE
ALTERNATIVE: BLDG1425-PLC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 1425BASE.LCC
ALTERNATIVE LCC FILE: 1425-PLC.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG1425BASE	ALTERNATIVE: BLDG1425-PLC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$11,518	-$11,518
SUBTOTAL	$0	$11,518	-$11,518
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$41,840	$41,840	$0
ENERGY-RELATED COSTS	$71,752	$53,859	$17,893
SUBTOTAL	$113,592	$95,699	$17,893
TOTAL P.V. LIFE-CYCLE COST	$113,592	$107,217	$6,375

NET SAVINGS FROM ALTERNATIVE BLDG1425-PLC COMPARED TO ALTERNATIVE BLDG1425BASE

Net Savings	=	P.V. of non-investment savings	$17,893
	-	Increased total investment	$11,518
		Net Savings:	$6,375

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG1425-PLC COMPARED TO ALTERNATIVE BLDG1425BASE

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 1.55$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG1425-PLC COMPARED TO ALTERNATIVE BLDG1425BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 7.74%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 6
Discounted Payback occurs in year 7

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Annual Consumption Alternative	Annual Consumption Savings	Life-Cycle Savings
Electricity	kWh	265,769	249,395	16,374	163,740
Central Steam	Pound	254,000	73,500	180,500	1,805,000

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Annual Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO_2 (Mg):	154.4	144.9	9.5	95.1
SOx (Kg):	1,297.1	1,217.2	79.9	498.7
NOx (Kg):	662.2	621.4	40.8	408.0
Central Steam:				
CO_2 (Kg):	0.0	0.0	0.0	0.0
SOx (Kg):	0.0	0.0	0.0	0.0
NOx (Kg):	0.0	0.0	0.0	0.0
Total:				
CO_2 (Mg):	154.4	144.9	9.5	95.1
SOx (Kg):	1,297.1	1,217.2	79.9	498.7
NOx (Kg):	662.2	621.4	40.8	408.0

Life Cycle Cost Analysis - ECO #3 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG1425BASE
ALTERNATIVE: BLDG1425-DDC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 1425BASE.LCC
ALTERNATIVE LCC FILE: 1425-DDC.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG1425BASE	ALTERNATIVE: BLDG1425-DDC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$48,993	-$48,993
SUBTOTAL	$0	$48,993	-$48,993
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$41,840	$31,147	$10,693
ENERGY-RELATED COSTS	$71,752	$49,072	$22,681
SUBTOTAL	$113,592	$80,218	$33,374
TOTAL P.V. LIFE-CYCLE COST	$113,592	$129,211	-$15,619

NET SAVINGS FROM ALTERNATIVE BLDG1425-DDC COMPARED TO ALTERNATIVE BLDG1425BASE

Net Savings =	P.V. of non-investment savings	$33,374
-	Increased total investment	$48,993
	Net Savings:	-$15,619

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG1425-DDC COMPARED TO ALTERNATIVE BLDG1425BASE

$$\text{SIR} = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 0.68$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG1425-DDC COMPARED TO ALTERNATIVE BLDG1425BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = -0.78%

ESTIMATED YEARS TO PAYBACK

Simple Payback never reached during study period
Discounted Payback never reached during study period

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Annual Consumption Alternative	Annual Consumption Savings	Life-Cycle Savings
Electricity	kWh	265,769	246,561	19,208	192,080
Central Steam	Pound	254,000	70,000	184,000	1,840,000

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Annual Emissions Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO_2 (Mg):	154.4	143.2	11.2	111.6
SOx (Kg):	1,297.1	1,203.4	93.7	585.0
NOx (Kg):	662.2	614.3	47.9	478.6
Central Steam:				
CO_2 (Kg):	0.0	0.0	0.0	0.0
SOx (Kg):	0.0	0.0	0.0	0.0
NOx (Kg):	0.0	0.0	0.0	0.0
Total:				
CO_2 (Mg):	154.4	143.2	11.2	111.6
SOx (Kg):	1,297.1	1,203.4	93.7	585.0
NOx (Kg):	662.2	614.3	47.9	478.6

Recommendations

Please note that these recommendations for ECO implementation are not applicable to building 1425, only to buildings with similar systems which do not have an EMS.

Energy Management System Evaluation Matrix

FUNCTION	PLC	DDC
Hot Water Reset	0	1
Supply Air Reset	--	--
Chilled Water Reset	0	1
Enthalpy Economizer	--	--
Time of Day Scheduling	10	10
Demand Limiting (Installation Wide)	0	2
Centralized Control	0	2
Centralized Monitoring	0	2
Expandability	1	2
Flexibility	1	1
Maintenance Scheduling	0	2
Optimum Start	1	1
Occupant Control/Override	1	1
Comfort Control	0	2
Reliability/Maintainability	1	2
Effect on Equipment Life	1	2
Maintenance Costs	1	1
Savings to Investment Ratio (SIR)	10	0
Total	27	32

The evaluation matrix above is intended to provide an objective comparison of two systems with widely varying capabilities. This matrix assigns relative value to the factors which were identified as being important in evaluating an EMS. From the results of this evaluation matrix the merits of the DDC system surpass those of the PLC system for this Building. The DDC system offers the greatest benefit for this building with respect to total Installation wide energy savings and HVAC system operation and maintenance. This system; however, does not provide a pay-back with-in the life of this study and does not qualify for funding under the current ECIP criteria.

The life cycle cost analyses indicated that the FMR and PLC systems meet the ECIP criteria.

The FMR system should be installed to cycle the chiller in accordance with the demand limiting strategy described in Example 2.1 of this study. The PLC system should be considered becuase it provides significant energy savings potential and qualifies for funding under the ECIP criteria. If there are any future renovations planned for this building that involve major mechanical system rework the DDC system will be the best alternative if installed at the time of renovation.

E. BUILDING 3136 - DAAF OPERATIONS BUILDING

Existing System Description

The existing building mechanical system consists of one chiller, one combination chilled water/hot water pump, numerous console fan-coil units, and several exhaust fans.

A packaged air cooled chiller provides chilled water for the entire building. This unit has self contained controls and cycles and stages its compressors to maintain a preset chilled water supply temperature. This chiller utilizes refrigerant R-22.

The entire building is served by a console type fan coil units which are equipped with combination hot/chilled water coils and are piped in a two-pipe arrangement. Each unit has a thermostat that cycles the fan on a call for heating or cooling. Ventilation air is provided through a wall louver at each unit and is controlled by a manual damper. These units are not equipped with control valve to regulate or stop the flow of water through the coils. During the heating season these units tend to act like radiators when ever there is hot water flowing in the building system. This can be a major source of discomfort and energy consumption because the rooms become overheated and as observed during our site visit the occupants are forced to open the windows to offset the "run away" heat. It was also noted during the site visit that the manual ventilation dampers in several of the fan coil units where completely closed or in-operable. Although it is beyond the scope of this study it should be noted that the age and poor condition of these fan coil units make them good candidates for replacement.

Hot water for building heating is provided through a steam to hot water convertor which utilizes a remote steam source which is controlled a pneumatically operated steam valve.

The two-pipe dual temperature piping system contains two change-over control valve which are used to change the system from cooling to heating and back again. This valve is controlled by a manual changer-over switch located on the wall of the basement mechanical room. There are no apparent safety controls on this change-over function which would prevent hot water from being circulated through the packaged chiller, a situation which could cause damage to the chiller and possible discharge of refrigerant into the atmosphere.

<u>Analysis of EMS Options</u>

DEMAND SAVINGS: The savings attributable to a demand limiting strategy as described in Example 2.1 for this building would be calculated as follows:

1 - 40 Ton Air Cooled Chiller

3 Compressors @ 39.4 Amps, 200 Volt, 3 Phase
3 x 39.4 x 200 x $\sqrt{3}$
= 40946 VA

4 Fan Motors @ 4.1 Amps x 200 Volt, 3 Phase
4 x 4.1 x 200 x $\sqrt{3}$
= 5681 VA

40946 VA + 5681 VA
= 46627 VA

= 46627 VA x 0.65 (Average Power Factor) x 1 kW/1000 Watts
= 30.3 kW

30.3 kW x $12.54/kW demand charge/month
= $380/month x 12 months/year
= $4560/year / 10 buildings
= <u>$456/year</u>

ECO #1 FMR: The FMR system can be utilized to limit the electric demand from this building in accordance with Example 2.1. The system would consist of one receiver/relay installed on the air cooled chiller (C-1) to cycle the units off in accordance with the demand strategy.

The system as described above will require an initial investment of approximately $558 and result in an estimated savings of $3,999 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of 7.17 and a payback period of 2 years.

ECO #2 PLC: The system would consist of one PLC relay for each electrical branch connection feeding a fan coil unit, it was assumed that this would result in approximately one relay for every 4 fan coil units. The air cooled chiller would also be connected to a relay. A stand-alone transceiver would be installed to control each relay and provide communication with a remote PC workstation through a modem connection. The transceiver would be capable of providing time of day scheduling for all connected equipment based on a pre-set adjustable schedule. The following is a control points list for this system:

PLC POINTS LIST

Building - 3136

Point Description	Motor Starter Interlock	Unit Control Circuit Interlock	Unit Power Circuit Interlock
Fan Coil Units (Typ. of 47)			
Fan Start/Stop			X
Packaged Air Cooled Chiller			
Chiller Enable/Disable		X	
Dual Temperature Water Pumps			
Pump Start/Stop	X		

The system as described above will require an initial investment of approximately $10,646 and result in an estimated savings of $17,738 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ratio (SIR) of 1.68 and a payback period of 6 years.

ECO #3 DDC: This system would consist of one stand-alone controller each for the air cooled chiller and hot water converter and one controller for each 8 fan coil units. The stand-alone controllers would provide time of day scheduling, night setback and historical data logging capabilities as well as hot water reset control for the converter. One stand-alone building control panel would provide the communications interface between each controller and demand limiting and optimum start capabilities. The controller will also allow for "dial-up" access from a remote PC workstation or communication through an Installation-wide fiber optic system with other buildings and PC work station The following is a control points list for this system:

DDC POINTS LIST

Building - 3136

Point Description	Binary Input	Analog Input	Binary Output	Analog Output
Fan Coil Units (Typ. of 47)				
Fan Start/Stop			X	
Chiller				
Chilled Water Supply Temperature		X		
Chilled Water Return Temperature		X		
Chiller Start/Stop			X	
Chiller Status	X			
Hot Water Convertor				
Steam Supply Pressure		X		
Hot Water Supply Temperature		X		
Hot Water Return Temperature		X		
Steam Valve				X
Dual Temperature Water Loop				
DTW Supply Temperature		X		
DTW Return Temperature		X		
DTW Pump Start/Stop			X	
DTW Pump Status	X			
Changeover Valve (Typ. of 2)			X	

The system as described above will require an initial investment of approximately $48,614 and result in an estimated savings of $32,715 over the study life. When compared to the existing baseline condition this ECO will result in an savings-to-investment ration (SIR) of .67 and there is no payback.

The following pages include the building simulation calculation and life cycle cost analysis results for the baseline conditions as well as each ECO.

Building Simulation Results - Baseline Condition and ECO #1

ANNUAL ENERGY COSTS

Building: Building 3136 - Baseline 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	82975 kWh	1633	0.139	16.4 %
Natural Gas	0	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	413 1000 lb	3292	0.280	33.0 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		4925	0.419	49.4 %
Electric	256487 kWh	5048	0.429	50.6 %
Natural Gas	0	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0 1000 lb	0	0.000	0.0 %
>>> Non-HVAC Subtotal		5048	0.429	50.6 %
>>> GRAND TOTAL		9973	0.848	100.0 %

* Cost per unit floor area is based on the gross building floor area.
Gross floor area................: 11760 sqft
Conditioned floor area..........: 10600 sqft

Building Simulation Results - ECO #2

ANNUAL ENERGY COSTS

Building: Building 3136 - PLC 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	75724 kWh	1490	0.127	17.8 %
Natural Gas	0	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	228 1000 lb	1818	0.155	21.8 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		3308	0.281	39.6 %
Electric	256487 kWh	5048	0.429	60.4 %
Natural Gas	0	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0 1000 lb	0	0.000	0.0 %
>>> Non-HVAC Subtotal		5048	0.429	60.4 %
>>> GRAND TOTAL		8356	0.711	100.0 %

* Cost per unit floor area is based on the gross building floor area.
Gross floor area................: 11760 sqft
Conditioned floor area..........: 10600 sqft

Building Simulation Results - ECO #3

ANNUAL ENERGY COSTS

Building: Building 3136 - DDC 01-05-95
Weather: Washington (Washington TMY) HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1 of 1

TABLE 1. COSTS BY ENERGY CATEGORY

Component	Annual Energy	Annual Costs ($)	Annual Costs ($/sqft)*	% of Total
Electric	75724 kWh	1490	0.127	17.8 %
Natural Gas	0	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	228 1000 lb	1818	0.155	21.8 %
Remote Cooling	0	0	0.000	0.0 %
>>> HVAC Subtotal		3308	0.281	39.6 %
Electric	256487 kWh	5048	0.429	60.4 %
Natural Gas	0	0	0.000	0.0 %
Fuel Oil	0	0	0.000	0.0 %
Propane	0	0	0.000	0.0 %
Remote Heating	0 1000 lb	0	0.000	0.0 %
>>> Non-HVAC Subtotal		5048	0.429	60.4 %
>>> GRAND TOTAL		8356	0.711	100.0 %

* Cost per unit floor area is based on the gross building floor area.
Gross floor area................: 11760 sqft
Conditioned floor area..........: 10600 sqft

Life Cycle Cost Analysis - ECO #1 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG3136BASE
ALTERNATIVE: BLDG3136-FMR

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 3136BASE.LCC
ALTERNATIVE LCC FILE: 3136-FMR.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG3136BASE	ALTERNATIVE: BLDG3136-FMR	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$558	-$558
SUBTOTAL	$0	$558	-$558
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$19,902	$19,902	$0
ENERGY-RELATED COSTS	$100,793	$96,794	$3,999
SUBTOTAL	$120,694	$116,695	$3,999
TOTAL P.V. LIFE-CYCLE COST	$120,694	$117,253	$3,442

NET SAVINGS FROM ALTERNATIVE BLDG3136-FMR COMPARED TO ALTERNATIVE BLDG3136BASE

Net Savings =	P.V. of non-investment savings	$3,999
-	Increased total investment	$558
	Net Savings:	$3,442

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG3136-FMR COMPARED TO ALTERNATIVE BLDG3136BASE

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 7.17$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG3136-FMR COMPARED TO ALTERNATIVE BLDG3136BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 25.55%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 2
Discounted Payback occurs in year 2

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Alternative	Savings	Life-Cycle Savings
Electricity	kWh	346,101	346,101	0	0
Central Steam	Pound	433,650	433,650	0	0

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO_2 (Mg):	201.0	201.0	0.0	0.0
SOx (Kg):	1,689.2	1,689.2	0.0	0.0
NOx (Kg):	862.3	862.3	0.0	0.0
Central Steam:				
CO_2 (Kg):	0.0	0.0	0.0	0.0
SOx (Kg):	0.0	0.0	0.0	0.0
NOx (Kg):	0.0	0.0	0.0	0.0
Total:				
CO_2 (Mg):	201.0	201.0	0.0	0.0
SOx (Kg):	1,689.2	1,689.2	0.0	0.0
NOx (Kg):	862.3	862.3	0.0	0.0

Life Cycle Cost Analysis - ECO #2 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG3136BASE
ALTERNATIVE: BLDG3136-PLC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 3136BASE.LCC
ALTERNATIVE LCC FILE: 3136-PLC.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG3136BASE	ALTERNATIVE: BLDG3136-PLC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$10,646	-$10,646
SUBTOTAL	$0	$10,646	-$10,646

FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	\$19,902	\$19,902	\$0
ENERGY-RELATED COSTS	\$100,793	\$82,855	\$17,938
SUBTOTAL	\$120,694	\$102,757	\$17,938
TOTAL P.V. LIFE-CYCLE COST	\$120,694	\$113,403	\$7,292

NET SAVINGS FROM ALTERNATIVE BLDG3136-PLC COMPARED TO ALTERNATIVE BLDG3136BASE

Net Savings =	P.V. of non-investment savings	\$17,938
-	Increased total investment	\$10,646
	Net Savings:	\$7,292

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG3136-PLC COMPARED TO ALTERNATIVE BLDG3136BASE

$$\text{SIR} = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 1.68$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG3136-PLC COMPARED TO ALTERNATIVE BLDG3136BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = 8.62%

ESTIMATED YEARS TO PAYBACK

Simple Payback occurs in year 6
Discounted Payback occurs in year 7

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Alternative	Savings	Life-Cycle Savings
Electricity	kWh	346,101	335,997	10,104	101,040
Central Steam	Pound	433,650	239,400	194,250	1,942,500

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO_2 (Mg):	201.0	195.2	5.9	58.7
SOx (Kg):	1,689.2	1,639.8	49.3	307.7
NOx (Kg):	862.3	837.1	25.2	251.7
Central Steam:				
CO_2 (Kg):	0.0	0.0	0.0	0.0

SOx (Kg):	0.0	0.0	0.0	0.0
NOx (Kg):	0.0	0.0	0.0	0.0
Total:				
CO2 (Mg):	201.0	195.2	5.9	58.7
SOx (Kg):	1,689.2	1,639.8	49.3	307.7
NOx (Kg):	862.3	837.1	25.2	251.7

Life Cycle Cost Analysis - ECO #3 vs. Baseline

NIST BLCC: COMPARATIVE ECONOMIC ANALYSIS (version 4.20-95)

BASE CASE: BLDG3136BASE
ALTERNATIVE: BLDG3136-DDC

PRINCIPAL STUDY PARAMETERS:

ANALYSIS TYPE: Federal Analysis--Energy Conservation Projects
STUDY PERIOD: 10.00 YEARS (JAN 1995 THROUGH DEC 2004)
DISCOUNT RATE: 3.1% Real (exclusive of general inflation)
BASE CASE LCC FILE: 3136BASE.LCC
ALTERNATIVE LCC FILE: 3136-DDC.LCC

COMPARISON OF PRESENT-VALUE COSTS

	BASE CASE: BLDG3136BASE	ALTERNATIVE: BLDG3136-DDC	SAVINGS FROM ALT.
INITIAL INVESTMENT ITEM(S):			
CASH REQUIREMENTS AS OF SERVICE DATE	$0	$48,614	-$48,614
SUBTOTAL	$0	$48,614	-$48,614
FUTURE COST ITEMS:			
ANNUAL AND NON-AN. RECURRING COSTS	$19,902	$10,736	$9,166
ENERGY-RELATED COSTS	$100,793	$77,243	$23,550
SUBTOTAL	$120,694	$87,979	$32,715
TOTAL P.V. LIFE-CYCLE COST	$120,694	$136,593	-$15,899

NET SAVINGS FROM ALTERNATIVE BLDG3136-DDC COMPARED TO ALTERNATIVE BLDG3136BASE

Net Savings	=	P.V. of non-investment savings	$32,715
	-	Increased total investment	$48,614
		Net Savings:	-$15,899

Note: the SIR and AIRR computations include differential initial costs, capital replacement costs, and resale value (if any) as investment costs, per NIST Handbook 135 (Federal and MILCON analyses only).

SAVINGS-TO-INVESTMENT RATIO (SIR)
FOR ALTERNATIVE BLDG3136-DDC COMPARED TO ALTERNATIVE BLDG3136BASE

$$SIR = \frac{\text{P.V. of non-investment savings}}{\text{Increased total investment}} = 0.67$$

ADJUSTED INTERNAL RATE OF RETURN (AIRR)
FOR ALTERNATIVE BLDG3136-DDC COMPARED TO ALTERNATIVE BLDG3136BASE
(Reinvestment rate = 3.10%; Study period = 10 years)

AIRR = -0.90%

ESTIMATED YEARS TO PAYBACK

Simple Payback never reached during study period
Discounted Payback never reached during study period

ENERGY SAVINGS SUMMARY

Energy type	Units	Annual Consumption Base Case	Alternative	Savings	Life-Cycle Savings
Electricity	kWh	346,101	332,211	13,890	138,900
Central Steam	Pound	433,650	228,000	205,650	2,056,500

EMISSIONS REDUCTION SUMMARY

Energy type	Annual Emissions Base Case	Alternative	Annual Reduction	Life-Cycle Reduction
Electricity:				
CO_2 (Mg):	201.0	193.0	8.1	80.7
SOx (Kg):	1,689.2	1,621.4	67.8	423.0
NOx (Kg):	862.3	827.7	34.6	346.1
Central Steam:				
CO_2 (Kg):	0.0	0.0	0.0	0.0
SOx (Kg):	0.0	0.0	0.0	0.0
NOx (Kg):	0.0	0.0	0.0	0.0
Total:				
CO_2 (Mg):	201.0	193.0	8.1	80.7
SOx (Kg):	1,689.2	1,621.4	67.8	423.0
NOx (Kg):	862.3	827.7	34.6	346.1

Recommendations

Energy Management System Evaluation Matrix

FUNCTION	PLC	DDC
Hot Water Reset	0	1
Supply Air Reset	--	--
Chilled Water Reset	0	1
Enthalpy Economizer	--	--
Time of Day Scheduling	10	10
Demand Limiting (Installation Wide)	0	2
Centralized Control	0	1
Centralized Monitoring	0	2
Expandability	1	2
Flexibility	2	2
Maintenance Scheduling	0	2
Optimum Start	1	1
Occupant Control/Override	1	1
Comfort Control	0	2
Reliability/Maintainability	1	2
Effect on Equipment Life	1	2
Maintenance Costs	1	1
Savings to Investment Ratio (SIR)	10	0
Total	28	32

The evaluation matrix above is intended to provide an objective comparison of two systems with widely varying capabilities. This matrix assigns relative value to the factors which were identified as being important in evaluating an EMS. From the results of this evaluation matrix the merits of the DDC system surpass those of the PLC system for this Building. The DDC system offers the greatest benefit for this building with respect to total Installation wide energy savings and HVAC system operation and maintenance. This system; however, does not provide a pay-back with-in the life of this study and does not qualify for funding under the current ECIP criteria.

The life cycle cost analyses indicated that the FMR and PLC systems meet the ECIP criteria.

The age and condition of the fan coil units and the control system in this building make it a candidate for a mechanical system replacement. An example is that the fan coil units are not equipped with control valves to stop the flow of water through coil when cooling or heating is not needed. This situation causes the fan coil units to act as radiators during the heating season even after the thermostat has been satisfied and has cycled the fan off. The installation of total system EMS at the time of new equipment installation would be more cost effective.

The building is served by a packaged air cooled chiller which can be cycled to provide electrical demand savings. This building should be equipped with and FMR relay and entered into a demand limiting schedule in accordance with the strategy outlined in Example 2.1 of this report.

APPENDICES

APPENDIX A
FIELD SURVEY DATA SHEETS

BUILDING 200

Air Cooled Condensing Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 200

Unit No. ACU-1 Location AMINO BLDG Area Served CHILLER C-1

Compressors:
Reciprocating X
Rotary ____

Number 1
Horsepower ____
FLA 211
LRA 791

Fans:
Number 6
RPM 1075

Horsepower 1.5
1 Φ

Electrical:
Volts 200
FLA ____

Phase 3
Hertz 60

Manufacturer TRANE
Model RAUA-C0C6EA -TYPE 621-0181-1A
SERIAL # 36-13374

Controls:
None X
HOA Switch ____

Motor Starter ____
D.S.

Remarks: COMPRESSORS ARE EQUIPPED W/ UNLOADERS WHICH WERE DISCONNECTED AT TIME OF SURVEY.

Air Cooled Condensing Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 66042.00

Building: 200

Unit No. ACCU-2 Location BEHIND BLDG Area Served CHILLER C-1

Compressors:
Reciprocating X
Rotary ____

Number 1
Horsepower ____
FLA 211
LRA 791

Fans:
Number 6
RPM 1075

Horsepower 15
1 φ

Electrical:
Volts 200
FLA ____

Phase 3
Hertz 60

Manufacturer TRANE
Model RAUA-6006-EA TYPE 621-0181-1A
SERIAL 36-13373

Controls:
None X
HOA Switch ____

Motor Starter ____

Remarks:

Air Handling Unit Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60698.00

Building: 200

Unit No. AHU-1 Location REAR MECH. ROOM Area Served ____

Air Type:
Constant Volume X
Variable Volume ____

Zone Type:
Single Zone X
Multi-Zone ____

Cooling:
Chilled Water X
None ____
DX ____

Heating:
Hot Water X
Electric ____
Steam ____
None ____

Supply Fan:
Forward Curved ____
Backward Incline ____
Airfoil ____

Controls:
Inlet Vanes ____
Variable Frequency Drive ____
Motor Starter X w/ P.E. RELAY
HOA Switch ____

Configuration:
Blow-Thru ____
Draw-Thru X
Horizontal ____
Vertical X

Motor
Horespower ____
Phase 3
Hertz 60
Volts 200
Amps ____

Manufacturer TRANE CLIMATE CHANGER
Model M-12 SERIAL # K3J247369

Return Air Fan:
Fan No. RAF-1
None ____

Economizer Controls:
None ____
Outdoor Enthalpy ____
Drybulb Comparison X ?
Outdoor Drybulb ____
Enthalpy Comparison ____

Remarks: 3 WAY PNEUMATIC VALVES CHILLED & HOT WATER

Fan Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60697.00

Building: 200

Unit No. RAF-1 Location REAR MECH. ROOM Area Served AHU-1

Fan Type:

Power Roof Ventilator ____
Utility Fan X
Inline Centrifugal ____
Ceiling Centrifugal ____

Forward Curved ____
Backward Incline ____
Airfoil ____

Motor:

Horespower ____
Phase 3
Hertz 60

Volts 200
Amps ____
RPM ____

Manufacturer TRANE
Model ____

Controls:

None ____
Inlet Vanes ____
HOA Switch ____

Motor Starter X w/ P.E. RELAY
Variable Frequency Drive ____

Remarks:

COULD NOT REACH MOTOR NAMEPLATE

Air Handling Unit Data Sheet

Project Name: F7 BLOCK EMS STUDY
Project Number: 60692.00
Building: 200

Unit No. AHU-2 Location MEZZANINE Area Served ____

Air Type:
Constant Volume X
Variable Volume ____

Zone Type:
Single Zone ____
Multi-Zone X

Cooling:
Chilled Water X
None ____
DX ____

Heating:
Hot Water X
Electric ____
Steam ____
None ____

Supply Fan:
Forward Curved ____
Backward Incline ____
Airfoil ____

Controls:
Inlet Vanes ____
Variable Frequency Drive ____
Motor Starter ____
HOA Switch ____

Configuration:
Blow-Thru X
Draw-Thru ____
Horizontal X
Vertical ____

Motor
Horsepower 10
Phase 3
Hertz 60
1760 RPM
Volts 200
Amps 34.4 HOA & OS

Manufacturer TRANE CLIMATE CHANGER
Model TYPE LZ-21 SERIAL # K3J247372

Return Air Fan:
Fan No. RAF-2
None ____

Economizer Controls:
None ____
Outdoor Enthalpy ____
Drybulb Comparison X ?
Outdoor Drybulb ____
Enthalpy Comparison ____

Remarks: 3 - ZONES PNEUMATIC ACTUATORS FOR ZONE DAMPERS

3-WAY VALVES ON CHILLED & HOT WATER

PNEUMATIC RETURN RELIEF & OA DAMPERS

Fan Data Sheet

Project Name: FT Belvoir EMS Study
Project Number: 606926

Building: 200

Unit No. RAF-2 Location MEZZANINE Area Served KHD-2

Fan Type:

- Power Roof Ventilator ____
- Utility Fan X
- Inline Centrifugal ____
- Ceiling Centrifugal ____
- Forward Curved ____
- Backward Incline X
- Airfoil ____

Motor:

- Horespower ____
- Phase 3
- Hertz 60
- Volts 200
- Amps ____
- RPM ____

Manufacturer TRANE
Model U30P-B1

Controls:

- None ____
- Inlet Vanes ____
- HOA Switch ____
- Motor Starter X
- Variable Frequency Drive ____

Remarks: DS. & [illegible] MOTOR STARTER & P.E. RELAY

NEMA SIZE 0 MOTOR STARTER SQUARE D
CLASS 8536 B11.5 HEATERS
TYPE
200/230 MAX 3HP
COULD NOT REACH MOTOR NAMEPLATE

Air Handling Unit Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

ilding: 200

Unit No. AHU 3 Location MEZZANINE

Area Served

Air Type:
Constant Volume X
Variable Volume ____

Zone Type:
Single Zone X
Multi-Zone ____

Cooling:
Chilled Water X
None ____
DX ____

Heating:
Hot Water X
Electric ____
Steam ____
None ____

Supply Fan:
Forward Curved ____
Backward Incline ____
Airfoil ____

Controls:
Inlet Vanes ____
Variable Frequency Drive ____
Motor Starter X
HOA Switch ____

nfiguration:
Blow-Thru ____
Draw-Thru X
Horizontal ____
Vertical ____

Motor
Horsepower 3.0
Phase 3
Hertz 60
Volts 200-208
Amps 10.6
1760 RPM

Manufacturer TRANE CLIMATE CHANGER
Model M-14 SERIAL K3J47370

Return Air Fan:
Fan No. RAF-3
None ____

Economizer Controls:
None ____
Outdoor Enthalpy ____
Drybulb Comparison X ?
Outdoor Drybulb ____
Enthalpy Comparison ____

Remarks:

3-WAY VALVES CHILLED WATER & HOT WATER
PNEUMATIC

PNEUMATIC RETURN, RELIEF & OA DAMPER AC

Fan Data Sheet

Project Name: Ft Belvoir EMS Study
Project Number: 60692.00

Building: 200

Unit No. RAF 3 Location Mezzanine Area Served AHU-3

Fan Type:

- Power Roof Ventilator ____
- Utility Fan X
- Inline Centrifugal ____
- Ceiling Centrifugal ____
- Forward Curved ____
- Backward Incline X
- Airfoil ____

Motor:

- Horespower ____
- Phase 3
- Hertz 60
- Volts 200
- Amps ____
- RPM ____

Manufacturer Trane
Model U-24-B1

Controls:

- None ____
- Inlet Vanes ____
- HOA Switch ____
- Motor Starter X
- Variable Frequency Drive ____

Remarks: D.S. Motor Starter W/ P.O. [illegible]
COULD NOT REACH MOTOR NAMEPLATE

Air Handling Unit Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 200

Unit No. AHU-4 Location MEZZANINE

Area Served ____

Air Type:
Constant Volume X
Variable Volume ____

Zone Type:
Single Zone ____
Multi-Zone X

Cooling:
Chilled Water X
None ____
DX ____

Heating:
Hot Water X
Electric ____
Steam ____
None ____

Supply Fan:
Forward Curved ____
Backward Incline ____
Airfoil ____

Controls:
Inlet Vanes ____
Variable Frequency Drive ____
Motor Starter X
HOA Switch ____

Configuration:
Blow-Thru X
Draw-Thru ____
Horizontal X
Vertical ____

Motor
Horsepower 5
Phase 3
Hertz 60
Volts 200
Amps 16.6 1760 RPM

Manufacturer TRANE CLIMATE CHANGER
Model MZ-14

Return Air Fan:
Fan No. RAF-4
None ____

Economizer Controls:
None ____
Outdoor Enthalpy ____
Drybulb Comparison X ?
Outdoor Drybulb ____
Enthalpy Comparison ____

Remarks:
7 ZONES W/ PNEUMATIC ZONE DAMPER ACTUATORS
PNEUMATIC 3-WAY VALVES CHILLED WATER & HOT WATER

Fan Data Sheet

Project Name: Ft Belvoir EMS Study
Project Number: 60692.00

Building: 200

Unit No. RAF-4 Location Mezzanine Area Served AHU-4

Fan Type:
- Power Roof Ventilator ____
- Utility Fan X
- Inline Centrifugal ____
- Ceiling Centrifugal ____

- Forward Curved ____
- Backward Incline X
- Airfoil ____

Motor:
- Horespower ____
- Phase 3
- Hertz 60

- Volts 200
- Amps ____
- RPM ____

Manufacturer Trane
Model U-27N-B1
Serial K3J248023

Controls:
- None ____
- Inlet Vanes ____
- HOA Switch X

- Motor Starter X w/ HOA & PB. Rotry
- Variable Frequency Drive ____

Remarks: Could not reach motor nameplate

Air Handling Unit Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60042.00
Building: 200

Unit No. AHU-5 Location MEZZANINE
Area Served

Air Type:
Constant Volume X
Variable Volume ____

Zone Type:
Single Zone X
Multi-Zone ____

Cooling:
Chilled Water X
None ____
DX ____

Heating:
Hot Water X
Electric ____
Steam ____
None ____

Supply Fan:
Forward Curved ____
Backward Incline ____
Airfoil ____

Controls:
Inlet Vanes ____
Variable Frequency Drive ____
Motor Starter X ?
HOA Switch X ?

Configuration:
Blow-Thru ____
Draw-Thru X
Horizontal X
Vertical ____

Motor
Horespower 5
Phase 3
Hertz 60
Volts 200
Amps 16.6
1760 RPM

Manufacturer TRANE CLIMATE CHANGER
Model MODEL L-17

Return Air Fan:
Fan No. RAF-5
None ____

Economizer Controls:
None ____
Outdoor Enthalpy ____
Drybulb Comparison X ?
Outdoor Drybulb ____
Enthalpy Comparison ____

Remarks: PNEUMATIC 3-WAY VALVES CHILLED & HOT WATER

Fan Data Sheet

Project Name: Ft Belvoir EMS Study
Project Number: 60692.00

Building: 200

Unit No. RAF-5 Location MEZZANINE Area Served AHU-5

Fan Type:

- Power Roof Ventilator ____
- Utility Fan X
- Inline Centrifugal ____
- Ceiling Centrifugal ____
- Forward Curved ____
- Backward Incline X
- Airfoil ____

Motor:

- Horespower ____
- Phase ____
- Hertz ____
- Volts ____
- Amps ____
- RPM ____

Manufacturer TRANE
Model U-27-B1
SERIAL# K3J248024

Controls:

- None ____
- Inlet Vanes ____
- HOA Switch X
- Motor Starter X w/ P.E. Lorm
- Variable Frequency Drive ____

Remarks: COULD NOT REACH MOTOR NAMEPLATE

Air Handling Unit Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 200

Unit No. AHU6 Location REAR MECH. ROOM Area Served ____

Air Type:
Constant Volume X
Variable Volume ____

Zone Type:
Single Zone X
Multi-Zone ____

Cooling:
Chilled Water ____
None X
DX ____

Heating:
Hot Water X
Electric ____
Steam ____
None ____

Supply Fan:
Forward Curved ____
Backward Incline ____
Airfoil ____

Controls:
Inlet Vanes ____
Variable Frequency Drive ____
Motor Starter X ?
HOA Switch X
5.5 AMP HEATERS

Configuration:
Blow-Thru ~~X~~
Draw-Thru X
Horizontal X
Vertical ____

Motor
Horespower ____
Phase ____
Hertz ____
Volts 200
Amps ____

Manufacturer TRANE CLIMATE CHANGER
Model ____

Return Air Fan:
Fan No. ____
None X

Economizer Controls:
None X
Outdoor Enthalpy ____
Drybulb Comparison ____
Outdoor Drybulb ____
Enthalpy Comparison ____

Remarks: 100% OUTSIDE AIR

Fan Data Sheet

Project Name: FT BELVOIR
Project Number: 60692.00

Building: 200

Unit No. EF 1 Location ____________ Area Served ____________

Fan Type:

Power Roof Ventilator ____
Utility Fan X
Inline Centrifugal ____
Ceiling Centrifugal ____

Forward Curved ____
Backward Incline ____
Airfoil ____

Motor:

Horespower ____
Phase ____
Hertz ____

Volts ____
Amps ____
RPM ____

Manufacturer ____________
Model ____________

Controls:

None ____
Inlet Vanes ____
HOA Switch ____

Motor Starter ____
Variable Frequency Drive ____

Remarks:

Fan Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 200

Unit No. EF-2 Location ____________ Area Served ____________

Fan Type:

- Power Roof Ventilator ____
- Utility Fan X
- Inline Centrifugal ____
- Ceiling Centrifugal ____
- Forward Curved ____
- Backward Incline ____
- Airfoil ____

Motor:

- Horespower ____
- Phase ____
- Hertz ____
- Volts ____
- Amps ____
- RPM ____

Manufacturer ____________
Model ____________

Controls:

- None ____
- Inlet Vanes ____
- HOA Switch ____
- Motor Starter ____
- Variable Frequency Drive ____

Remarks:

Fan Data Sheet

Project Name: FT BELVOIR EMS STUDY

Project Number: 100692

Building: 200

Unit No. EF 4 Location MEZZANINE Area Served ____

Fan Type:

Power Roof Ventilator ____
Utility Fan X
Inline Centrifugal ____
Ceiling Centrifugal ____

Forward Curved X
Backward Incline ____
Airfoil ____

Motor:

Horespower ____
Phase ____
Hertz ____

Volts ____
Amps ____
RPM ____

Manufacturer TRANE

Model U-963-FC
983?

Controls:

None ____
Inlet Vanes ____
HOA Switch ____

Motor Starter ____
Variable Frequency Drive ____

Remarks:

COULD NOT REACH MOTOR NAME PLATE

CUTLER HAMMER SNAP SWITCH W/INDICATOR LIGHT

Fan Data Sheet

Project Name: Ft Belvoir EMS Stud
Project Number: 60692.00

Building: 200

Unit No. PRV-1 Location Roof Area Served ______

Fan Type:
- Power Roof Ventilator X
- Utility Fan ____
- Inline Centrifugal ____
- Ceiling Centrifugal ____
- Forward Curved ____
- Backward Incline ____
- Airfoil ____

Motor:
- Horsepower ____
- Phase ____
- Hertz ____
- Volts ____
- Amps ____
- RPM ____

Manufacturer ______
Model ______

Controls:
- None ____
- Inlet Vanes ____
- HOA Switch ____
- Motor Starter ____
- Variable Frequency Drive ____

Remarks:

Fan Data Sheet

Project Name: Ft Belvoir EMS Study
Project Number: 60692.00

Building: 200

Unit No. PRV-2 Location Roof Area Served ____

Fan Type:

Power Roof Ventilator X
Utility Fan ____
Inline Centrifugal ____
Ceiling Centrifugal ____

Forward Curved ____
Backward Incline ____
Airfoil ____

Motor:

Horespower ____
Phase ____
Hertz ____

Volts ____
Amps ____
RPM ____

Manufacturer ____
Model ____

Controls:

None ____
Inlet Vanes ____
HOA Switch ____

Motor Starter ____
Variable Frequency Drive ____

Remarks:

Fan Coil Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 200

Unit No. CUH-1 Location ENTRY VESTIBULE Area Served ENTRY VESTIBULE

Cooling:
- Chilled Water ____
- None X

Heating:
- Hot Water ____
- Steam ____
- Electric ____ - ____ KW
- None ____

Fan Motor
- Horespower ____
- Phase ____
- Hertz ____
- Volts ____
- Amps ____
- RPM ____

Electrical:
- Volts ____
- Hertz ____
- Phase ____
- FLA ____

Manufacturer TRANE
Model ____

Controls:
- Self Contained ____
- Outside Air ____
- Remote X T-STAT & FAN SPEED SWITCH

Remarks:

Fan Coil Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 10069?.00

Building: ______

Unit No. CUH-2 Location ENTRY VESTIBULE Area Served ENTRY VESTIBULE

Cooling:
- Chilled Water ____
- None X

Heating:
- Hot Water ____
- Steam ____
- Electric ____ - _____ KW
- None ____

Fan Motor
- Horespower ____
- Phase ____
- Hertz ____
- Volts ____
- Amps ____
- RPM ____

Electrical:
- Volts ____
- Hertz ____
- Phase ____
- FLA ____

Manufacturer TRANE
Model ____

Controls:
- Self Contained ____
- Outside Air ____
- Remote X T-STAT & FAN SPEED SWITCH

Remarks:

BOILER
~~Pump Data Survey~~ Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60492.00

Building: 200

Unit No. B-1 Location REAR MECH ROOM Area Served ENTIRE BLDG

Motor:

Horespower ____ Volts ____
Phase ____ Amps ____
Hertz ____ RPM ____

Manufacturer AVCO SPENCER DIVISION
Model 4F-311-0/W SERIAL # 4344 SHELL 4-311

Controls:

None ____ Variable Frequency Drive ____
Motor Starter ____ HOA Switch ____

Remarks:

HEATING SURFACE 289 SQ FT
GROSS OUTPUT 1339
NET RATING 1165
40 HP
OIL 12 GPH
GAS 2 MBH
BURNER MODEL 58-0-05
7.0 GPH MIN
12.0 GPM MAX

BURNER 208 3 Ø 1.9 AMP

OIL ONLY

Pump Data Survey Sheet

Project Name: Ft Belvoir EMS Study
Project Number: 60692.00

Building: 200

Unit No. P-1 Location Rear Mech Room Area Served Chilled Water

Motor:

Horespower 7.5
Phase 3
Hertz 60

Volts 200-208
Amps 23
RPM 1750

Manufacturer Bell & Gossett
Model 4BB - 8-1/8 BF

Controls:

None ____
Motor Starter X

Variable Frequency Drive ____
HOA Switch X

Remarks:

Base Mounted End Suction

Pump Data Survey Sheet

Project Name: Ft Belvoir EMS Survey
Project Number: 806922.00

Building: 200

Unit No. P.2 Location Rear Mech. Rm Area Served Hot Water Pump

Motor:

Horsepower 3
Phase 3
Hertz 60

Volts 208
Amps 8.5
RPM 1725

Manufacturer Bell & Gossett
Model 2 1/2 AB 71MP Series 1510

Controls:

None ____
Motor Starter X
Variable Frequency Drive ____
HOA Switch X

Remarks: Base Mounted End-Suction

Pump Data Survey Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692,00

Building: 200

Unit No. P3 Location REAR MECH ROOM Area Served STANDBY PUMP

Motor:

Horespower 3
Phase 3
Hertz 60

Volts 200
Amps 10.8
RPM 1740

Manufacturer
Model

Controls:

None ____
Motor Starter ____

Variable Frequency Drive ____
HOA Switch ____

Remarks:

BASE MOUNTED END SUCTION

Pump Data Survey Sheet

Project Name: Ft Belvoir EMS Study
Project Number: 66692.00

Building: 700

Unit No. P-4 Location Rear Mech Rm Area Served AHU-6

Motor:

Horespower ____ Volts ____
Phase ____ Amps ____
Hertz ____ RPM ____

Manufacturer Bell & Gossett
Model

Controls:

None ____ Variable Frequency Drive ____
Motor Starter X HOA Switch ____

Remarks: Cutler Hammer Snap Switch w/ indicator light

Inline Centrifugal

Pump Data Survey Sheet

Project Name: FT BELVOIR EMS SYSTEM
Project Number: 60692.00

Building: 200

Unit No. P-5 Location REAR MECH RM Area Served FINNED TUBE

Motor:

Horespower ____ Volts ____
Phase ____ Amps ____
Hertz ____ RPM ____

Manufacturer BELL & GOSSET
Model

Controls:

None ____ Variable Frequency Drive ____
Motor Starter X HOA Switch ____

Remarks: P.E. LOCALLY CONTROLLED
CUTLER HAMMER SNAP SWITCH W/ INDICATOR LIGHT
INLINE CENTRIFUGAL

THREE-WAY VALVE

BUILDING 219

BOILER
~~Pump~~ Data Survey Sheet

Project Name: FT BELVOIR EMS
Project Number: 60692.00

Building: 219A

Unit No. B-1 Location BASEMENT MECH RM Area Served ENTIRE BLDG

Motor:

Horespower ____ Volts ____
Phase ____ Amps ____
Hertz ____ RPM ____

Manufacturer WEIL McLEAN
Model BOILER MODEL COULD NOT BE READ

Controls:

None ____ Variable Frequency Drive ____
Motor Starter ____ HOA Switch ____

Remarks: PEABODY GORDON PIATT BURNER OIL FIRED

19 GPH RLS 8.2-0-10

CAST IRON OLD !

15PSI RELIEF VALVE

HW RESET

55°	90°
27 1/2	135
0°	180

BOILER

Pump Data Survey Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. B-2 Location AUDITORIUM BASEMENT Area Served ENTIRE BLDG

Motor:

Horespower ____ Volts ____
Phase ____ Amps ____
Hertz ____ RPM ____

Manufacturer WEIL McLAIN
Model NO NAME PLATE FOUND

Controls:

None ____ Variable Frequency Drive ____
Motor Starter ____ HOA Switch ____

Remarks:

CAST IRON BOILER
PEABODY GORDON PIATT OIL BURNER
19 GPH

Chiller Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. C-1 Location SOUTH MECH ROOM Area Served BLDG 219

Compressors:
- Reciprocating X
- Centrifugal ____
- Rotary ____

Number 2
Horespower ____
RLA 55

Condenser Type:
- Air Cooled Packaged ____
- Air Cooled Split (Condensing Unit ____)

Air Cooled Remote X (Condenser ACC-1)
Water Cooled ____ (Cooling Tower ____)

Electrical:
- Volts 460
- FLA ____

Phase 3
Hertz 60

Manufacturer TRANE
Model CCUA0604 MB51 DF4C4C361 CEH
SERIAL L78C11022

Controls:
- None X
- HOA Switch ____

Motor Starter ____

Remarks:
COMPRESSORS TRANE CRHM 300C-26 AT
R-22 460V3Ø SERIAL A7M30A 3003
LRA 240 " A7M30A 2999
RLA 55.0

60 TON

Air Cooled Condenser Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. ACC-1 Location OUTSIDE SOUTH MECH RM Area Served BLDG 219 - C-1

Fans:
Number 2
RPM ____

Horsepower 7.5
11.0 FLA (EA)

Electrical:
Volts 460
FLA ____
MCA 25

Phase 3
Hertz 60

Manufacturer TRANE
Model CAUA - 8004 - 0A

Controls:
None ____
HOA Switch ____

Motor Starter ____

Remarks:

Chiller Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219A

Unit No. C-1A Location REAR OF 219A Area Served BLDG 219 A

Compressors:
- Reciprocating X
- Centrifugal ___
- Rotary ___

Number 2
Horsepower ___
~~FLA~~ RLA 40.0

Condenser Type:
- Air Cooled Packaged X
- Air Cooled Split (Condensing Unit ___)

Air Cooled Remote ___ (Condenser ___)
Water Cooled ___ (Cooling Tower ___)

Electrical:
- Volts 460
- FLA 50 AMP (EA) 2 CIRCUITS

Phase 3
Hertz 60

Manufacturer TRANE
Model CGAA0401 NB51CC4C4C361BEU
SERIAL # L78K13974
TYPE # C4328-839-01

Controls:
- None ___
- HOA Switch ___

Motor Starter ___

Remarks: 2 COMPRESSORS 460 V-3Ø-60 HZ RLA 40.0 LRA 178

40 TON

Air Handling Unit Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00
Building: 219A
Unit No. AHU-1A Location AUDITORIUM MECH ROOM Area Served AUDITORIUM

Air Type:
Constant Volume X
Variable Volume ____

Zone Type:
Single Zone ____
Multi-Zone ____

Cooling:
Chilled Water X
None ____
DX ____

2 PIPE

Heating:
Hot Water X
Electric X REHEAT
Steam ____
None ____

Supply Fan:
Forward Curved ____
Backward Incline ____
Airfoil X

Controls:
Inlet Vanes ____
Variable Frequency Drive ____
Motor Starter X
HOA Switch X

Configuration:
Blow-Thru ____
Draw-Thru X
Horizontal X
Vertical ____

Motor
Horespower 3 182 T
Phase 3
Hertz 60
Volts ____
Amps ____

Manufacturer SUPPLY FAN: TRANE
Model MODEL CF24A1DW3CWUBSH
TYPE B3108-0015-1A SERIAL # K78H41473

Return Air Fan:
Fan No. ____ ?
None ____

Economizer Controls:
None ____
Outdoor Enthalpy ____
Drybulb Comparison ____
Outdoor Drybulb ____
Enthalpy Comparison X

Remarks:
FIELD BUILT-UP

2-WAY PNEUMATIC VALVE FOR WATER
BARBER COLEMAN PNEUMATIC CONTROLS
JOHNSON CONTROLS N-9000 ENTHALPY LOGIC CONTROLLER
RC-1 WINTER CONTROL 70° 7.8 DA
RC-2 SUMMER CONTROL 76° 9.24 DA
RC-3 HUMIDITY CONTROL 50% 7.3 RA

Air Handling Unit Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 6069200

Building: 219

Unit No. AHU-1B Location SOUTH MECH RM

Area Served INTERIOR ZONE

Air Type:
- Constant Volume X
- Variable Volume ____

Zone Type:
- Single Zone X
- Multi-Zone ____

Cooling:
- Chilled Water X
- None ____
- DX ____

2 PIPE

Heating:
- Hot Water X
- Electric ____
- Steam ____
- None ____

Supply Fan:
- Forward Curved X
- Backward Incline ____
- Airfoil ____

Controls:
- Inlet Vanes ____
- Variable Frequency Drive ____
- Motor Starter X
- HOA Switch X

Configuration:
- Blow-Thru ____
- Draw-Thru X
- Horizontal ____
- Vertical X

Motor
- Horespower 7.5
- Phase 3
- Hertz 60
- Volts 230/460
- Amps 24/12

Manufacturer TRANE CLIMATE CHANGER
Model TYPE L-31 SERIAL # K78C32075

Return Air Fan:
- Fan No. ____
- None ____

Economizer Controls:
- None ____
- Outdoor Enthalpy ____
- Drybulb Comparison ____
- Outdoor Drybulb ____
- Enthalpy Comparison ____

Remarks: BARBER COLEMAN PNEUMATIC CONTROLS
PNEUMATIC 3 WAY

Fan Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. RAF-1 Location ATTIC BLDG 219 Area Served AHU-1

Fan Type:

Power Roof Ventilator ____
Utility Fan ____
Inline Centrifugal ____
Ceiling Centrifugal ____

Forward Curved ____
Backward Incline ____
Airfoil ____

Motor:

Horespower ____
Phase ____
Hertz ____

Volts ____
Amps ____
RPM ____

Manufacturer ____
Model ____

Controls:

None ____
Inlet Vanes ____
HOA Switch ____

Motor Starter ____
Variable Frequency Drive ____

Remarks:

Air Handling Unit Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00
Building: 219

Unit No. AHU-2 Location BASEMENT UPS ROOM Area Served UPS ROOM

Air Type:
Constant Volume X
Variable Volume ___

Zone Type:
Single Zone X
Multi-Zone ___

Cooling:
Chilled Water ___
None ___
DX X

Heating:
Hot Water ___
Electric ___
Steam ___
None X

Supply Fan:
Forward Curved X
Backward Incline ___
Airfoil ___

Controls:
Inlet Vanes ___
Variable Frequency Drive ___
Motor Starter ___
HOA Switch ___

Configuration:
Blow-Thru ___
Draw-Thru X
Horizontal X
Vertical ___

Motor
Horespower 1.5
Phase 1
Hertz 60
Volts 115/208-230
Amps 17.4

Manufacturer CARRIER
Model 40BA007-301BA

Return Air Fan:
Fan No. ___
None X

Economizer Controls:
None X
Outdoor Enthalpy ___
Drybulb Comparison ___
Outdoor Drybulb ___
Enthalpy Comparison ___

Remarks: NOT OPERATING AT TIME OF SURVEY

Air Cooled Condensing Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. ACCU-2 Location BEHIND BLDG Area Served AHU-2 (UPS ROOM)

Compressors:
Reciprocating X
Rotary ____

Number 1
Horsepower ____
RLA 13.5
LRA 69

Fans:
Number ____
RPM ____

Horsepower ____

Electrical:
Volts 460
~~FLA~~ MCA 18.1

Phase 3
Hertz 60

Manufacturer CARRIER
Model 38AFP007 600

Controls:
None ____
HOA Switch ____

Motor Starter ____

Remarks:

Fan Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. EF1 Location ____________ Area Served ____________

Fan Type:

Power Roof Ventilator ____
Utility Fan ____
Inline Centrifugal ____
Ceiling Centrifugal ____

Forward Curved ____
Backward Incline ____
Airfoil ____

Motor:

Horsepower ____
Phase ____
Hertz ____

Volts ____
Amps ____
RPM ____

Manufacturer ____________
Model ____________

Controls:

None ____
Inlet Vanes ____
HOA Switch ____

Motor Starter ____
Variable Frequency Drive ____

Remarks:

Fan Coil Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. FCU-A Location ______ Area Served ______

Cooling:
- Chilled Water X
- None ____

Heating:
- Hot Water X
- Steam ____
- Electric ____ - ____ KW
- None ____

Fan Motor
- Horsepower 1/60
- Phase ____
- Hertz ____
- Volts 115V
- Amps ____
- RPM ____

Electrical:
- Volts ____
- Hertz ____
- Phase ____
- FLA ____

Manufacturer TRANE
Model B22A002

Controls:
- Self Contained ____
- Outside Air ____
- Remote ____

Remarks: 2 PIPE W/ ELECTRIC CONTROL VALVES

Fan Coil Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. FCU-B Location ______ Area Served ______

Cooling:
Chilled Water X
None ____

Heating:
Hot Water X
Steam ____
Electric ____ - ____ KW
None ____

Fan Motor
Horsepower 1/30
Phase ____
Hertz ____
Volts ____
Amps ____
RPM ____

Electrical:
Volts 115V
Hertz 60
Phase 1
FLA 1.4

Manufacturer TRANE
Model B22A003

Controls:
Self Contained X
Outside Air ____
Remote ____

Remarks: 2 PIPE W/ ELECTRIC 2-WAY CONTROL VALVE

Fan Coil Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. FCU-D Location ______ Area Served ______

Cooling:
Chilled Water X
None ____

Heating:
Hot Water X
Steam ____
Electric ____ - ____ KW
None ____

Fan Motor
Horespower 1/30
Phase ____
Hertz ____

Volts 115
Amps ____
RPM ____

Electrical:
Volts ____
Hertz ____

Phase ____
FLA ____

Manufacturer TRANE
Model B22A004

Controls:
Self Contained X
Outside Air X

Remote ____

Remarks: 2 PIPE W/ ELECTRIC CONTROL VALVE

Fan Coil Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. FCU-E Location ______ Area Served ______

Cooling:
- Chilled Water X
- None ____

Heating:
- Hot Water X
- Steam ____
- Electric ____ - ____ KW
- None ____

Fan Motor
- Horsepower 1/20
- Phase ____
- Hertz ____
- Volts 115
- Amps ____
- RPM ____

Electrical:
- Volts ____
- Hertz ____
- Phase ____
- FLA ____

Manufacturer TRANE
Model B22A006

Controls:
- Self Contained X
- Outside Air ____
- Remote ____

Remarks: 2 PIPE W/ ELECTRIC CONTROL VALVE

Fan Coil Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. FCU-F Location ____ Area Served ____

Cooling:
- Chilled Water X
- None ____

Heating:
- Hot Water X
- Steam ____
- Electric ____ - ____ KW
- None ____

Fan Motor
- Horespower 1/12
- Phase 1
- Hertz ____
- Volts 115
- Amps 1.6
- RPM ____

Electrical:
- Volts ____
- Hertz ____
- Phase ____
- FLA ____

Manufacturer TRANE
Model B22 A008

Controls:
- Self Contained ____
- Outside Air ____
- Remote ____

Remarks: 2 PIPE W/ ELECTRIC CONTROL VALVE

Pump Data Survey Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. P-1A Location ~~BASEMENT~~ MECH RM Area Served AUDITORIUM

Motor:

Horespower 2
Phase 3
Hertz ____
Volts 208/230-460
Amps 6.3/6.2-3.1
RPM 3450

Manufacturer BELL & GOSSETT
Model SERIES 1535 359 T B09

Controls:

None ____
Motor Starter ____
Variable Frequency Drive ____
HOA Switch ____

Remarks:

Pump Data Survey Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. P-1B Location BASEMENT MECH RM Area Served DUAL TEMPERATURE WATER PUMP

Motor:
- Horespower 5
- Phase 3
- Hertz 60
- Volts 230/460
- Amps 14.4/7.2
- RPM 1745

Manufacturer BELL & GOSSETT
Model SERIES 1510 2BB 8-3/4 BF
SERIAL NO. 847504

Controls:
- None ____
- Motor Starter X
- Variable Frequency Drive ____
- HOA Switch X

Remarks:
END SUCTION
BASE MOUNTED

Pump Data Survey Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 219

Unit No. P-2 Location BASEMENT MECH RM. Area Served STEAM CONDENSATE PUMP

Motor:

Horespower 3/4 (2) Volts 230/460
Phase ____ Amps 2.6/1.3
Hertz ____ RPM 1725

Manufacturer ____
Model ____

Controls:

None ____ Variable Frequency Drive ____
Motor Starter ____ HOA Switch ____

Remarks:

BUILDING 247

Boiler Survey Data Sheet

Project Name: Ft Belvoir EMS Study
Project Number: 60692.00

Building: 247

Unit No. B-1 Location BASEMENT MECH ROOM AreaServed ____

Type:
Cast Iron X
Steel ____
Hot Water X
Steam ____

Capacity:
Input Rating ____ MBH
Net Rating ____ MBH

Manufacturer WEIL McLAIN

Model CL 170

Burner:
Gas X
Oil X
Input 4474 MBH
Input 31 Gal/Hr

Manufacturer WEBSTER

Model JB2C-30-R7795C LL.25 SERIAL W019685-1

Controls:
None ____
Low Water Cut-off X
Automatic Feedwater Valve ____
Make-up Water PRV ____

Remarks:
CAST

Boiler Survey Data Sheet

Project Name: Ft Belvoir EMS Study
Project Number: 60692.00

STAND-BY

Building: 247

Unit No. B-2 Location BASEMENT MECH ROOM AreaServed ______

Type:

Cast Iron ____
Steel ____
Hot Water ____
Steam ____

Capacity:

Input Rating ________ MBH
Net Rating ________ MBH

Manufacturer WEIL-MCLAIN

Model ______

Burner:

Gas X
Oil X
Input 4474 MBH
Input 31 Gal/Hr

Manufacturer WEBSTER

Model JB2C-30-R7795C-LL.25 SERIAL W019685-2

Controls:

None ____
Low Water Cut-off X
Automatic Feedwater Valve ____
Make-up Water PRV____

Remarks:

Chiller Survey Data Sheet

Project Name: ______________________________

Project Number: __________

Building: ____

Unit No. C-1 Location ____________________ Area Served ______________________

Compressors:
- Reciprocating ____
- Centrifugal X
- Rotary ____

Number ____
Horespower ____
FLA ____

Condenser Type:
- Air Cooled Packaged ____
- Air Cooled Split (Condensing Unit ____)

Air Cooled Remote ____ (Condenser ____)
Water Cooled ____ (Cooling Tower ____)

Electrical:
- Volts 460
- FLA ____

Phase 3
Hertz 60

Manufacturer YORK

Model YT B2 C3 C1 - CKP

Controls:
- None ____
- HOA Switch ____

Motor Starter X WESTINGHOUSE

Remarks: R-11 MCA 314 MOCP 600

COMPRESSOR YDTJ-85 CODE KY
SERIAL NO. YCTM-083252

305 AMP @ 460-3Φ-60 Hz

NOMINAL 300 .66-.71

2-PASS 213 @ 44°F LEAVING

900 EVAPORATOR
900 CONDENSER

A-51

Cooling Tower Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 247

Unit No. CT-1 Location OUTSIDE BOILER RM Area Served C-1

Configuration:
Draw Thru X
Blow Thru ____
Standard Height X
Low Silhouette ____

Motor:
High Speed:
Horsepower 15
Phase 3
Hertz 60
Volts 200
Amps 44.8
RPM 1765

Low Speed:
Horsepower ____
Phase ____
Hertz ____
Volts ____
Amps ____
RPM ____

Manufacturer MARLEY
Model ____
SERIAL # 8908 6-329-85

Controls:
None ____
Motor Starter X
HOA Switch ____
Variable Frequency Drive ____
Two Speed Motor ____

Remarks:

Air Cooled Condensing Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60698.00

Building: 247

Unit No. ACCU-1 Location PENTHOUSE MECH ROOM Area Served AUDITORIUM AHU

Compressors:
Reciprocating X
Rotary ____

Number 1
Horsepower 60
FLA ____ 142/71

Fans:
Number ____
RPM ____

Horsepower ____

Electrical:
Volts 220/440
FLA 142/71

Phase 3
Hertz 60

Manufacturer CHRYSLER AIR TEMP - RADIAL
Model 2007 02 PART # 1423686

Controls:
None ____
HOA Switch ____

Motor Starter X COMBINATION DS/MS

Remarks:
W/ REMOTE CONDENSER ACC-1

UNIT IS DISCONNECTED FROM DX COIL
AND PIPING IS OPEN

CONTROLS HAVE BEEN DISABLED

Air Cooled Condenser Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 247

Unit No. ACC-1 Location ROOF Area Served AUDITORIUM (ACCO-1)

Fans:
Number 6
RPM ____
Horsepower 1

Electrical:
Volts 460
FLA ____
MCA 11
Phase 3
Hertz 60

Manufacturer TRANE
Model CAUBC6042A01
SERIAL 0856 60502

Controls:
None X
HOA Switch ____
Motor Starter ____

Remarks:

Air Handling Unit Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 247

Unit No. AHU   Location ______________

Area Served AUDITORIUM

Air Type:
- Constant Volume X
- Variable Volume ____

Zone Type:
- Single Zone X
- Multi-Zone ____

Cooling:
- Chilled Water ~~X~~
- None ____
- DX X

Heating:
- Hot Water X
- Electric ____
- Steam ____
- None ____

Supply Fan:
- Forward Curved ____
- Backward Incline ____
- Airfoil ____

Controls:
- Inlet Vanes ____
- Variable Frequency Drive ____
- Motor Starter X W/ PE SWITCH
- HOA Switch ____

Configuration:
- Blow-Thru ~~X~~
- Draw-Thru X
- Horizontal X
- Vertical ____

Motor
- Horespower 10
- Phase 3
- Hertz 60
- Volts 208
- Amps 30
- RPM 1750

Manufacturer FIELD BUILT-UP
Model ______________

Return Air Fan:
- Fan No. ____
- None X

Economizer Controls:
- None ____
- Outdoor Enthalpy ____
- Drybulb Comparison ____
- Outdoor Drybulb ____
- Enthalpy Comparison ____

Remarks: PNEUMATIC 3-WAY CONTROL VALVE FOR HOT WATER
PNEUMATIC DAMPER ACTUATOR FOR RETURN / OA.
ROBERTSHAW RECEIVER CONTROLLER COOLING
" " " HEATING
JOHNSON CONTROLS T-8000 - PROP ACTING T-5?7
ROBERTSHAW GRADUAL SWITCH AND PRESSURE REGULATOR
FOR SUMMER WINTER [illegible] DAMPER [illegible]

A-55

Air Handling Unit Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 247

Unit No. AHU-1B Location ____________ Area Served ____________

Air Type:
Constant Volume X
Variable Volume ____

Zone Type:
Single Zone X
Multi-Zone ____

Cooling:
Chilled Water X
None ____
DX ____

Heating:
Hot Water X
Electric ____
Steam ____
None ____

Supply Fan:
Forward Curved ____
Backward Incline ____
Airfoil ____

Controls:
Inlet Vanes ____
Variable Frequency Drive ____
Motor Starter ____
HOA Switch ____

Configuration:
Blow-Thru ____
Draw-Thru X
Horizontal ____
Vertical X

Motor
Horespower ____
Phase ____
Hertz ____
Volts ____
Amps ____

Manufacturer TRANE
Model FAN [illegible] MCCA008G66

SERIAL# K91J32733

Return Air Fan:
Fan No. ____
None ____

Economizer Controls:
None X
Outdoor Enthalpy ____
Drybulb Comparison ____
Outdoor Drybulb ____
Enthalpy Comparison ____

Remarks:
JOHNSON CONTROLS ELECTRIC [illegible] HOT WATER VALVE & CHILLED WATER & 2-WAY HEATING VALVE

ELECTRIC OUTSIDE AIR DAMPER ACTUATOR

CHANGE OVER AQUASTAT INDIVIDUAL COILS HOT & CHILLED

2-PIPE SYSTEM

JOHNSON TIME CLOCK

SALES ENG. SOG JJL

A-56

Fan Coil Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 247

Unit No. FC-1 Location ____________ Area Served ____________

Cooling:
- Chilled Water X
- None ____

Heating:
- Hot Water X
- Steam ____
- Electric ____ - ____ KW
- None ____

Fan Motor
- Horespower ____
- Phase ____
- Hertz ____
- Volts ____
- Amps ____
- RPM ____

Electrical:
- Volts ____
- Hertz ____
- Phase ____
- FLA ____

Manufacturer INTERNATIONAL ENVIRONMENTAL CORP.
Model ____________

Controls:
- Self Contained ____
- Outside Air ____
- Remote ____

Remarks:
2 WAY ELECTRIC CONTROL VALVE
2- PIPE HEATING/COOLING

Pump Data Survey Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 247

Unit No. P-1 Location BASEMENT MECH ROOM Area Served HEATING PUMP

Motor:
Horsepower 7.5
Phase 3
Hertz 60

Volts 230/460
Amps 21.6/10.8
RPM 1740

Manufacturer AKKORA PUMPS
Model 76-12369-2 TYPE 361 BF
SIZE 2.5X9

Controls:
None ____
Motor Starter X
Variable Frequency Drive ____
HOA Switch X

Remarks:
W/ PE SWITCH

JOHNSON CONTROLS T-5800-3 PROP. RECEIVER CONT.

160 GPM
75 FT

1750 RPM

Pump Data Survey Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 247

Unit No. P-2 Location BASEMENT MECH ROOM Area Served HEATING PUMP

Motor:

Horespower 7.5 Volts 230/460
Phase 3 Amps 21.6/10.8
Hertz 60 RPM 1740

Manufacturer AURORA
Model 91-09175 ~~[illegible]~~ 361A-BF
SIZE 2.5X3X9

Controls:

None ____ Variable Frequency Drive ____
Motor Starter X HOA Switch X

Remarks: w/ P.E. SWITCH

Pump Data Survey Sheet

Project Name: ______
Project Number: ______

Building: ______

Unit No. P-7 Location BASEMENT MECH RM Area Served HEATING WATER PUMPS

Motor:

Horespower 5
Phase ____
Hertz ____

Volts 208/230 - 460
Amps 15.2/14.4 - 7.2
RPM 1150

Manufacturer TACO
Model FM5010 8.3 B2G1D1L0

Controls:

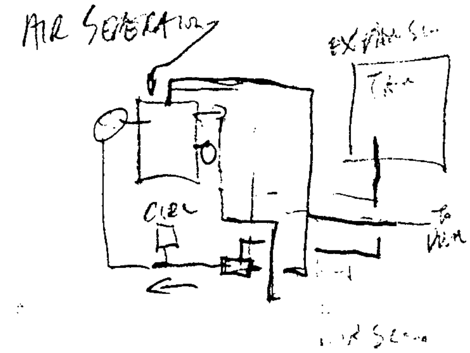
None ____
Motor Starter X

Variable Frequency Drive ____
HOA Switch X

Remarks:

W/ REMOTE BULB T-STATS FOR O.A.

BASE MOUNTED END SUCTION CENTRIFUGAL



Pump Data Survey Sheet

Project Name: ______________________

Project Number: _____

Building: _____

Unit No. ____ Location ______________________ Area Served HOT WATER ~~[illegible]~~ CIRCULATOR

Motor:

Horsepower 1/3 Volts 115

Phase 1 Amps ____

Hertz 60 RPM 1725

Manufacturer TACO INLINE CIRCULATOR

Model ______________________ 5/89

Controls:

None ____ Variable Frequency Drive ____

Motor Starter X MANUAL HOA Switch ____

Remarks:

Pump Data Survey Sheet

LEFT

Project Name: FT BELVOIR EMS STUDY
Project Number: 60698.00

Building: 247

Unit No. 1-B Location BASEMENT MECH ROOM Area Served CHILLED WATER PUMP

Motor:

Horespower 10
Phase 3
Hertz 60

Volts 208
Amps 28
RPM 1740

Manufacturer AURORA
Model 967-12744 TYPE GB-PA-BF
SIZE 4X5X9B

Controls:

None ____
Motor Starter X

Variable Frequency Drive ____
HOA Switch ____

Remarks:
510 GPM 51 FT

Pump Data Survey Sheet

P1GA4

Project Name: FT BELVOIR EMS STUDY
Project Number: 60693.00

Building: 247

Unit No. P-9 Location BASEMENT MECH ROOM Area Served CHILLED WATER PUMP

Motor:
Horespower 10
Phase 3
Hertz 60
Volts 208
Amps 28
RPM 1740

Manufacturer AURORA
Model 67-12744-2 TYPE GBPA-8F
SIZE 4X5X9B

Controls:
None ____
Motor Starter X
Variable Frequency Drive ____
HOA Switch ____

Remarks:

Pump Data Survey Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 247

Unit No. P-6 Location BASEMENT MECH ROOM Area Served CONDENSER WATER PUMPS

Motor:
- Horespower 10
- Phase 3
- Hertz 60
- Volts 208
- Amps 28
- RPM 1750

Manufacturer AURORA
Model 967-12745-1 TYPE 6<A-BF SIZE 5X6X9

Controls:
- None ___
- Motor Starter X
- Variable Frequency Drive ___
- HOA Switch X

Remarks: 702 GPM 37.5 FT

Pump Data Survey Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 247

Unit No. ____ Location BASEMENT MECH ROOM Area Served CONDENSER WATER

Motor:

Horsepower 10
Phase 3
Hertz 60

Volts 230/460
Amps 27.4/13.7
RPM 1145

Manufacturer AURORA
Model 88-5918 TYPE 344A-SF
SIZE 5X6X11

Controls:

None ____
Motor Starter X

Variable Frequency Drive ____
HOA Switch X

Remarks:

702 GPM 37.5 FT

1160 RPM

BUILDING 1425

A-66

Chiller Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 1425

Unit No. C-1 Location OUTSIDE EAST SIDE OF BLDG Area Served ______

Compressors:
- Reciprocating X
- Centrifugal ____
- Rotary ____

Number 3
Horespower ____
RLA 39.4
LRA 247

Condenser Type:
- Air Cooled Packaged ____
- Air Cooled Split (Condensing Unit _____)
- Air Cooled Remote ____ (Condenser _____)
- Water Cooled ____ (Cooling Tower ______)

Electrical:
- Volts 200
- FLA ____
- MCA 184
- Phase 3
- Hertz 60

Manufacturer TRANE
Model CGADC40GAF A1G TUR / SERIAL J92H33098

Controls:
- None ____
- HOA Switch ____
- Motor Starter ____

Remarks:

Fan Coil Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 1425

Unit No. FCU-1 Location ______ Area Served ______

Cooling:
Chilled Water X
None ____

2 PIPE

Heating:
Hot Water X
Steam ____
Electric ____ - ____ KW
None ____

Fan Motor
Horespower ____
Phase ____
Hertz ____
Volts ____
Amps ____
RPM ____

Electrical:
Volts ____
Hertz ____
Phase ____
FLA ____

Manufacturer TRANE
Model ______

Controls:
Self Contained ____
Outside Air ____
Remote ____

Remarks: 3-WAY [illegible] CONTROL VALVE

Fan Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 1425

Unit No. EF-1 Location ROOF Area Served RESTROOM EXHAUST

Fan Type:

Power Roof Ventilator ____
Utility Fan ____
Inline Centrifugal ____
Ceiling Centrifugal ____

Forward Curved ____
Backward Incline ____
Airfoil ____

Motor:

Horespower ____
Phase ____
Hertz ____

Volts ____
Amps ____
RPM ____

Manufacturer ____________________

Model ____________________

Controls:

None ____
Inlet Vanes ____
HOA Switch ____

Motor Starter ____
Variable Frequency Drive ____

Remarks:

Pump Data Survey Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 1425

Unit No. P-1 Location BASEMENT MECH ROOM Area Served CHILLED/HEATING WATER

Motor:

Horsepower 5
Phase 3
Hertz 60

Volts 208/230-460
Amps 13.8-13.2/6.6
RPM 1740

Manufacturer ~~[illegible]~~ AMTROL / THRUSH PUMPS
Model 1 1/4 X 1 1/2 X 9PF SERIES 2300

Controls:

None ____
Motor Starter X Comb/IQ
Variable Frequency Drive ____
HOA Switch ✓

Remarks: 195 GPM @ 75 Ft HEAD

Pump Data Survey Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 1425

Unit No. P-2 Location BASEMENT MECH ROOM Area Served CHILLED/HEATING WATER STANDBY

Motor:

Horespower ____ Volts ____
Phase ____ Amps ____
Hertz ____ RPM _______

Manufacturer ____
Model ____

Controls:

None ____ Variable Frequency Drive ____
Motor Starter ____ HOA Switch ____

Remarks:

Same as Pump P-1

BUILDING 3136

Chiller Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 3136

Unit No. C1 Location ~~BASEMENT MECH~~ OUTSIDE ROOF(?) Area Served ____

Compressors:
- Reciprocating X
- Centrifugal ____
- Rotary ____

Number 2
Horsepower 1
LRA 394
RLA 72.2

Condenser Type:
- Air Cooled Packaged X
- Air Cooled Split (Condensing Unit ____)

Air Cooled Remote ____ (Condenser ____)
Water Cooled ____ (Cooling Tower ____)

Electrical:
- Volts 200
- FLA ____
- MCA 179

Phase ____
Hertz ____

Manufacturer TRANE
Model CGACC406 KANEE 4236
SERIAL J88A6069

Controls:
- None ____
- HOA Switch ____

Motor Starter ____

Remarks: 4 CONDENSER FANS 4.1 FLA EACH
1 HORSE POWER

CONVERTER w/ 2 WAY STEAM VALVE [illegible] ON [illegible] TEMPERATURE AND THERMOSTAT, [illegible] STEAM TEMP, [illegible] IN MECH ROOM

[illegible]

[illegible] CHANGEOVER

[illegible]

A-73

Fan Coil Unit Survey Data Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: ______

Building: 3136

Unit No. FCU Location ______ Area Served ______

Cooling:
Chilled Water X
None ____

2 PIPE

Heating:
Hot Water X
Steam ____
Electric ____ - ____ KW
None ____

Fan Motor
Horsepower ____ Volts ____
Phase ____ Amps ____
Hertz ____ RPM ____

Electrical:
Volts ____ Phase ____
Hertz ____ FLA ____

Manufacturer ______
Model ______

Controls:
Self Contained X Remote ____
Outside Air X MANUAL

Remarks:
NO CONTROL VALVES

WINDOWS OPEN BECAUSE HOT WATER IS ALWAYS ON.

Pump Data Survey Sheet

Project Name: FT BELVOIR EMS STUDY
Project Number: 60692.00

Building: 3136

Unit No. P-1 Location BASEMENT MECH ROOM Area Served CHILLED/HEATING WATER

Motor:
Horespower 5
Phase 3
Hertz 60

Volts 208-230/460
Amps 11.3-11.3/5.65
RPM 3150

Manufacturer
Model

Controls:
None ____
Motor Starter X
Variable Frequency Drive ____
HOA Switch ____

Remarks:

APPENDIX B
MECHANICAL EQUIPMENT LOCATION PLANS

BUILDING 200

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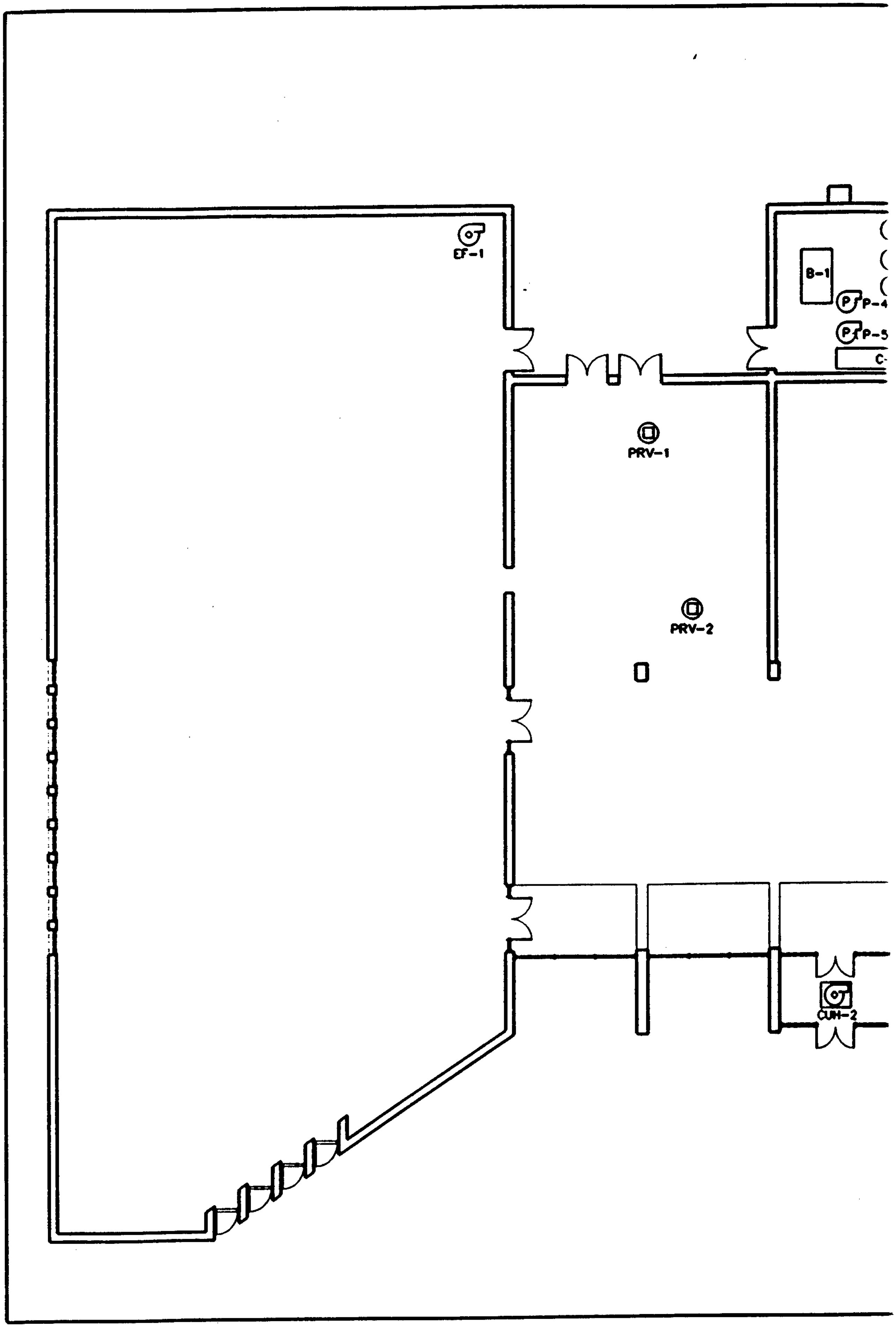


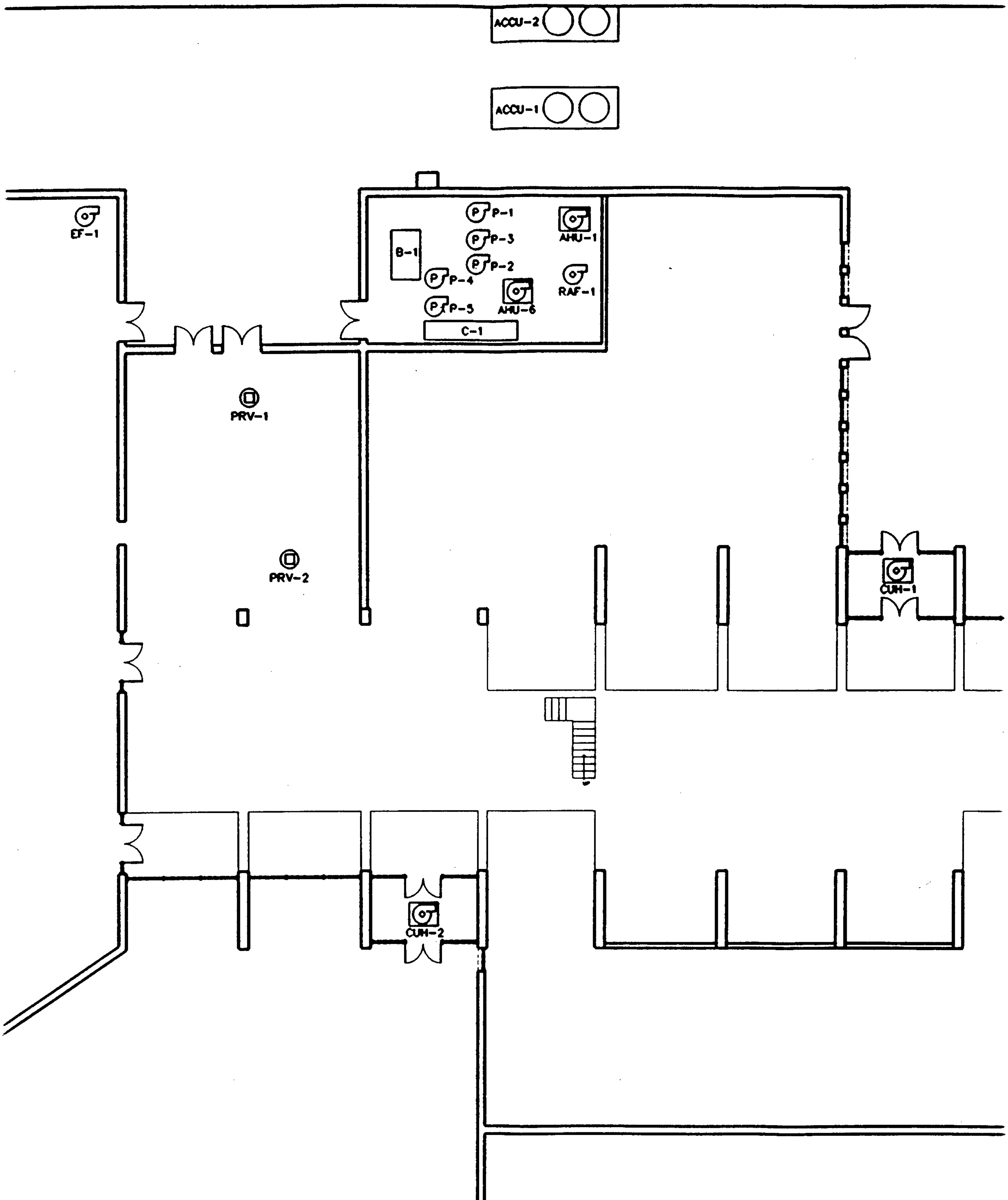
Project: FT. BELVOIR EMS STUDY

Project No.: 60692.00

Designed by: DLS

Drawn by

① B 2



)Y

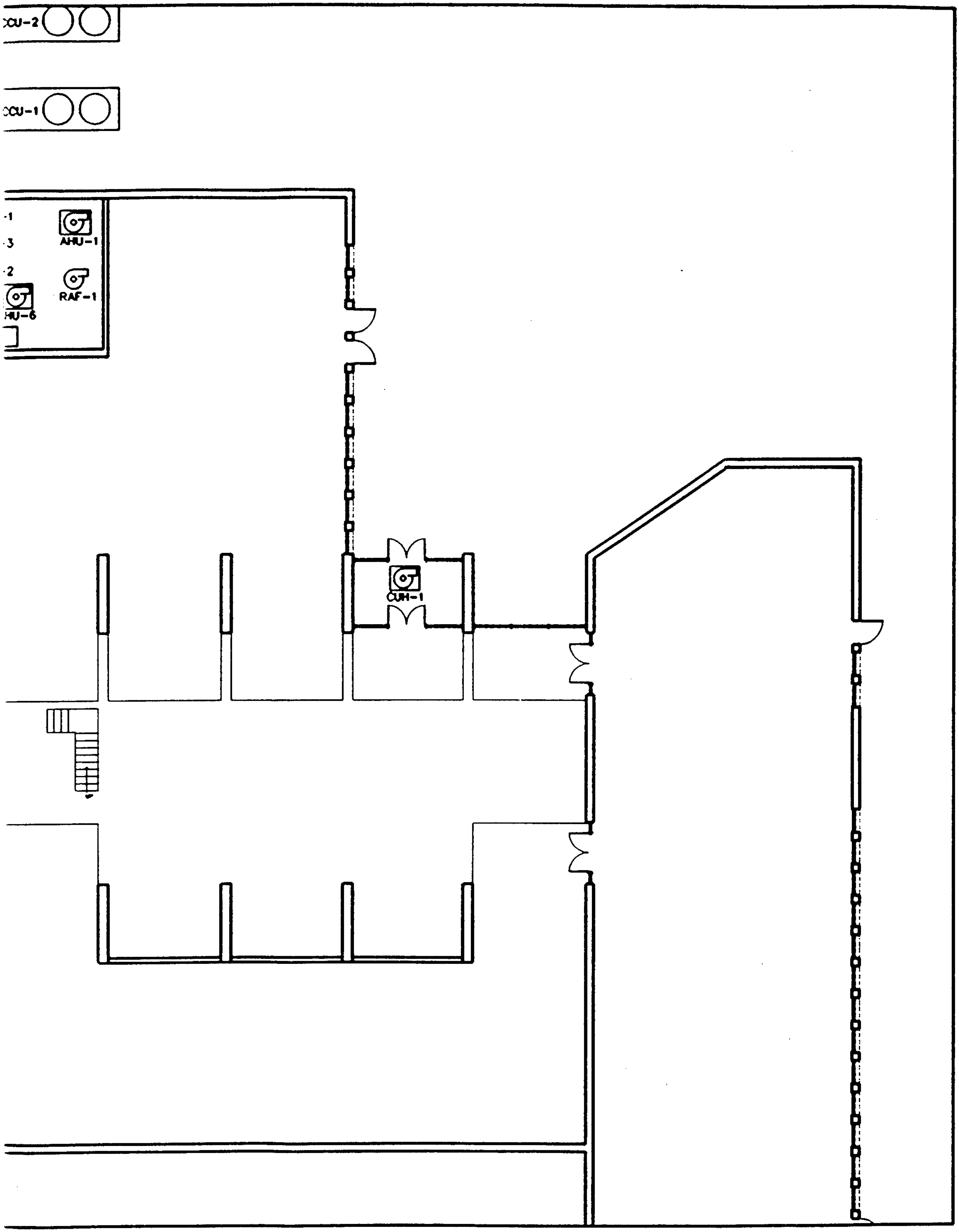
Project No.: 60692.00
Designed by: DLS
Drawn by

Title: BUILDING 200 – FIRST FLOOR
EQUIPMENT LOCATION PLAN

Modifies Drawing No.

Scale: 1/16"=1'-0"

2



Title: BUILDING 200 - FIRST FLOOR EQUIPMENT LOCATION PLAN

Date: 14 JULY 94

Sheet No.: 1 of 2

Modifies Drawing No.

Scale: 1/16"=1'-0"

Drawing No.:

3

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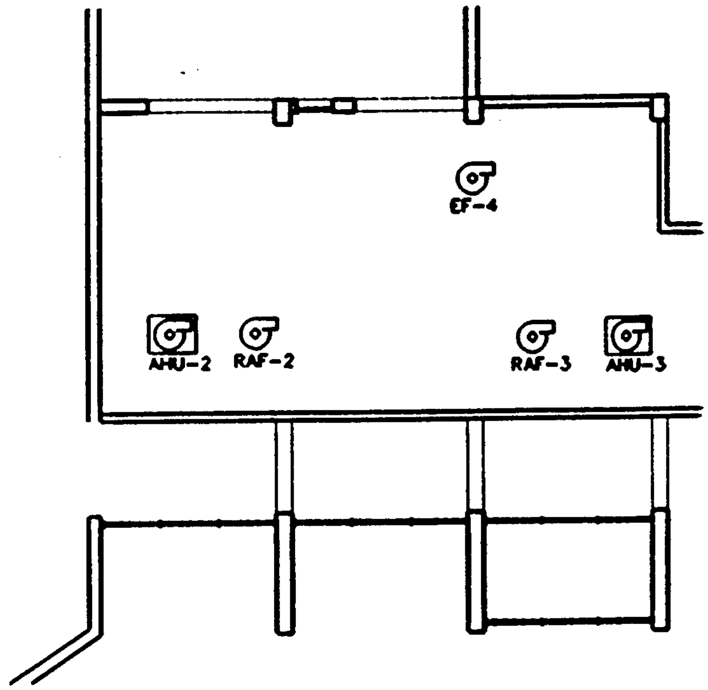
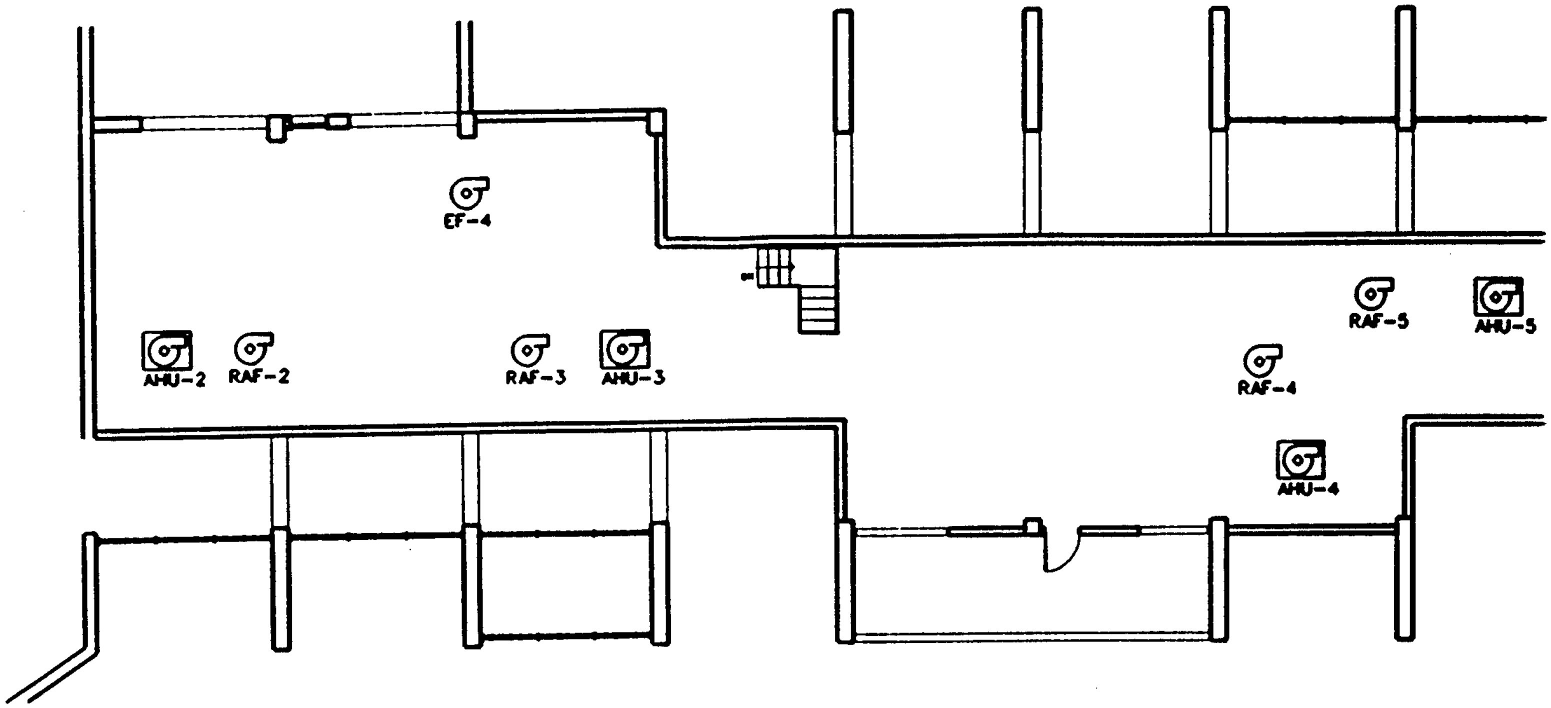


Project: FT. BELVOIR EMS STUDY

Project No: 60692.00
Designed by: DLS
Drawn by:

B3-1



Y

Project No: 60692.00

Designed by: DLS

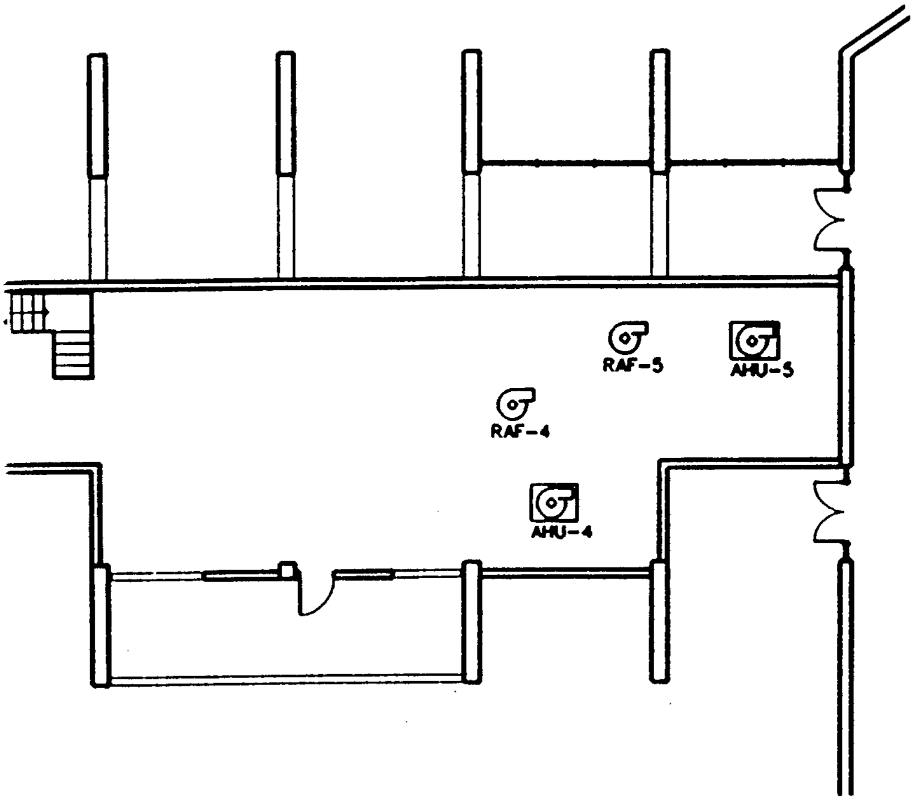
Drawn by:

(2)

Title: BUILDING 200 – MEZANINE EQUIPMENT LOCATION PLAN

Modifies Drawing No.

Scale 1/16"=1'-0"



Title: BUILDING 200 – MEZANINE
EQUIPMENT LOCATION PLAN

Date: 14 JULY 94
Sheet No.: 2 of: 2

Modifies Drawing No.: Scale 1/16"=1'-0" Drawing No.:

3

BUILDING 219

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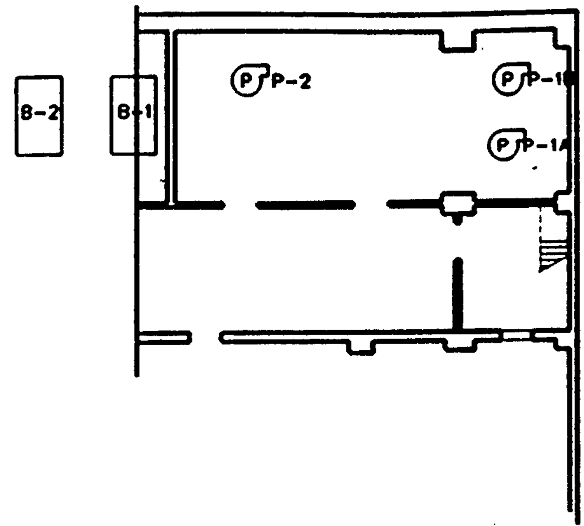


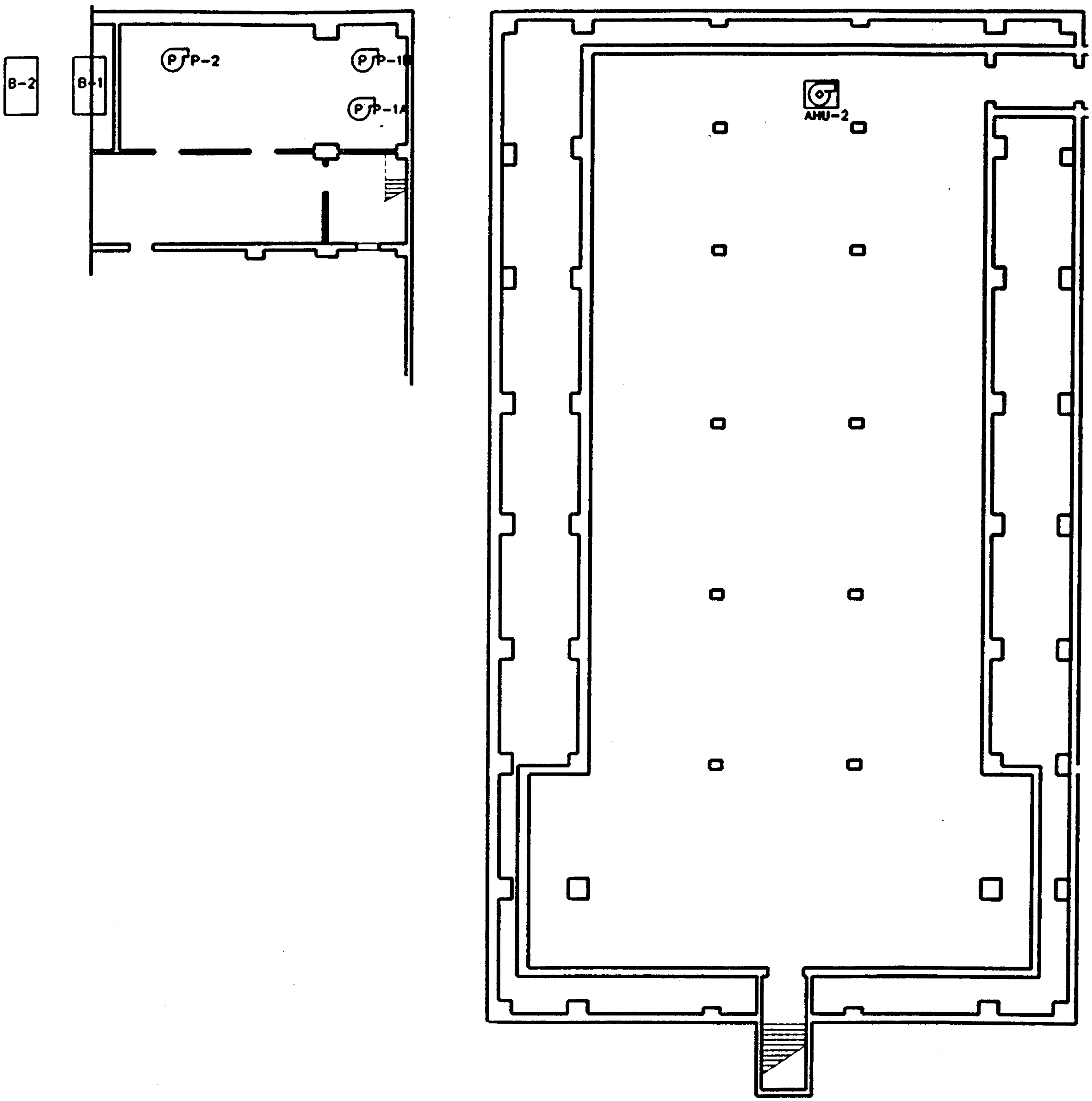
Project: FT. BELVOIR EMS STUDY

Project No.: 60692.00

Designed by:

Drawn by DLS

B-5 (1)



Project No.: 60692.00

Designed by:

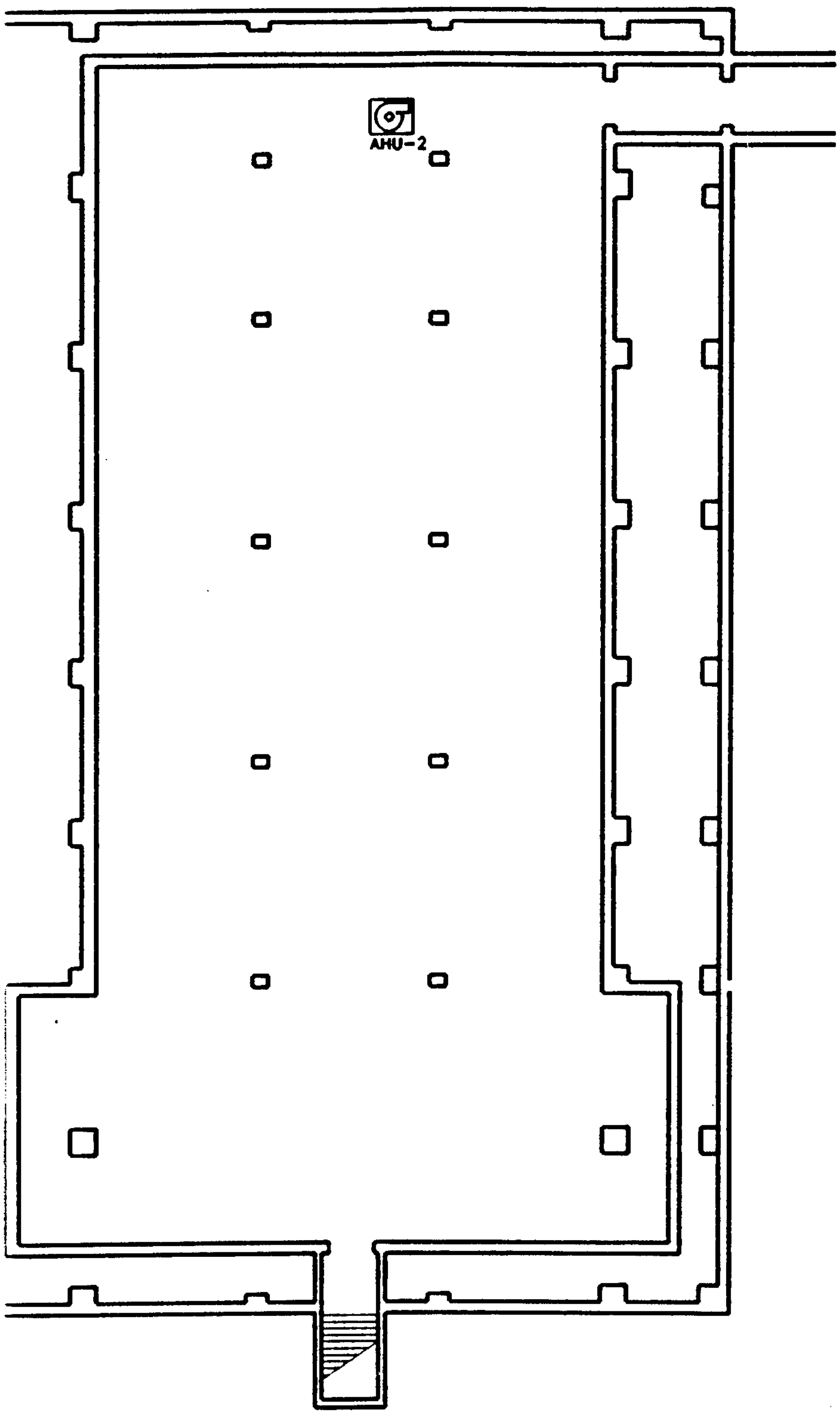
Drawn by DLS

2

Title: BUILDING 219 - BASEMENT EQUIPMENT LOCATION PLAN

Modifies Drawing No.

Scale: 1/16"=1'-0"



BUILDING 219 – BASEMENT
EQUIPMENT LOCATION PLAN

Date: 14 JULY 94
Sheet No.: 1 of 3
...ifies Drawing No.
Scale: 1/16"=1'-0"
Drawing No.:

(3)

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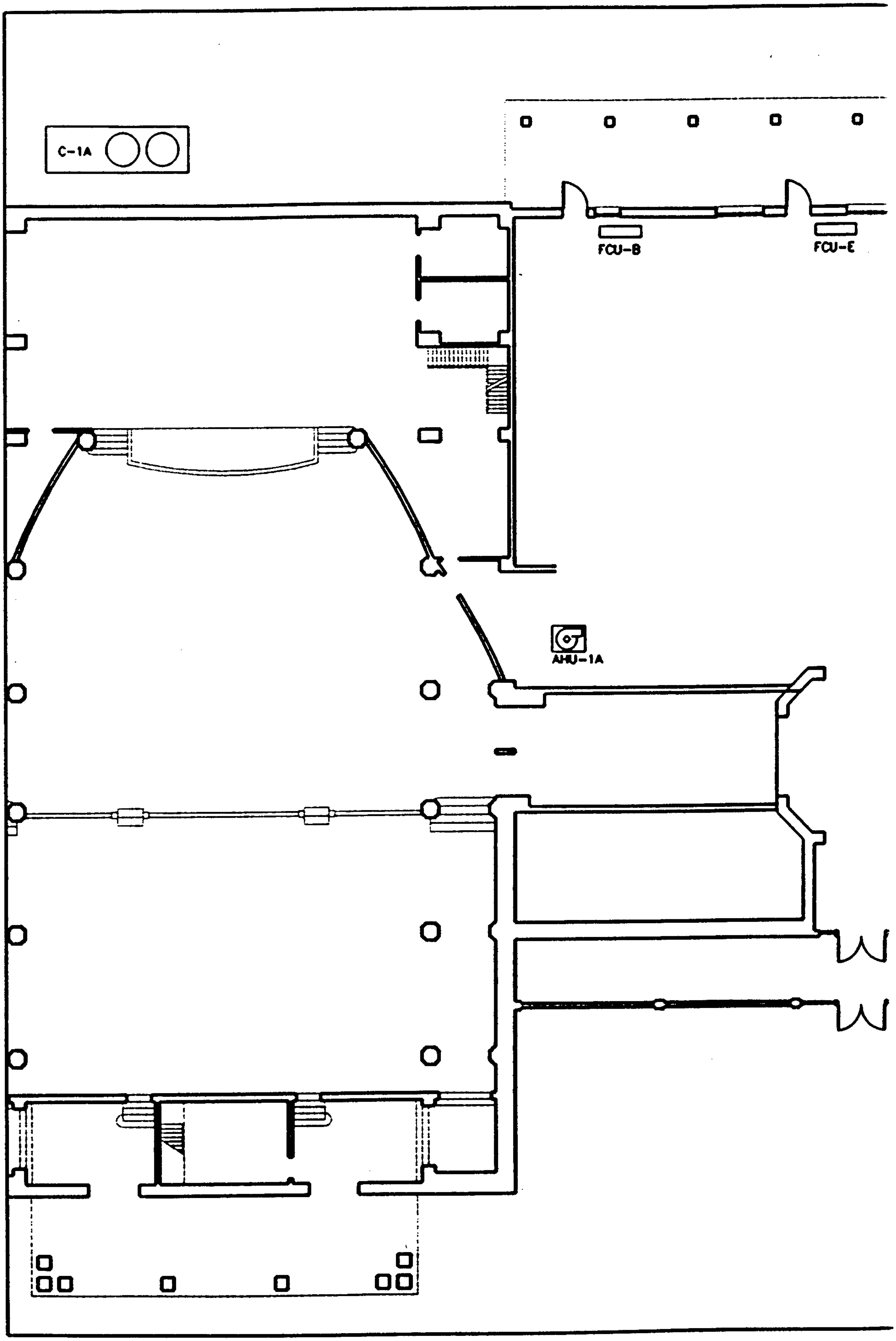


Project: FT. BELVOIR EMS STUDY

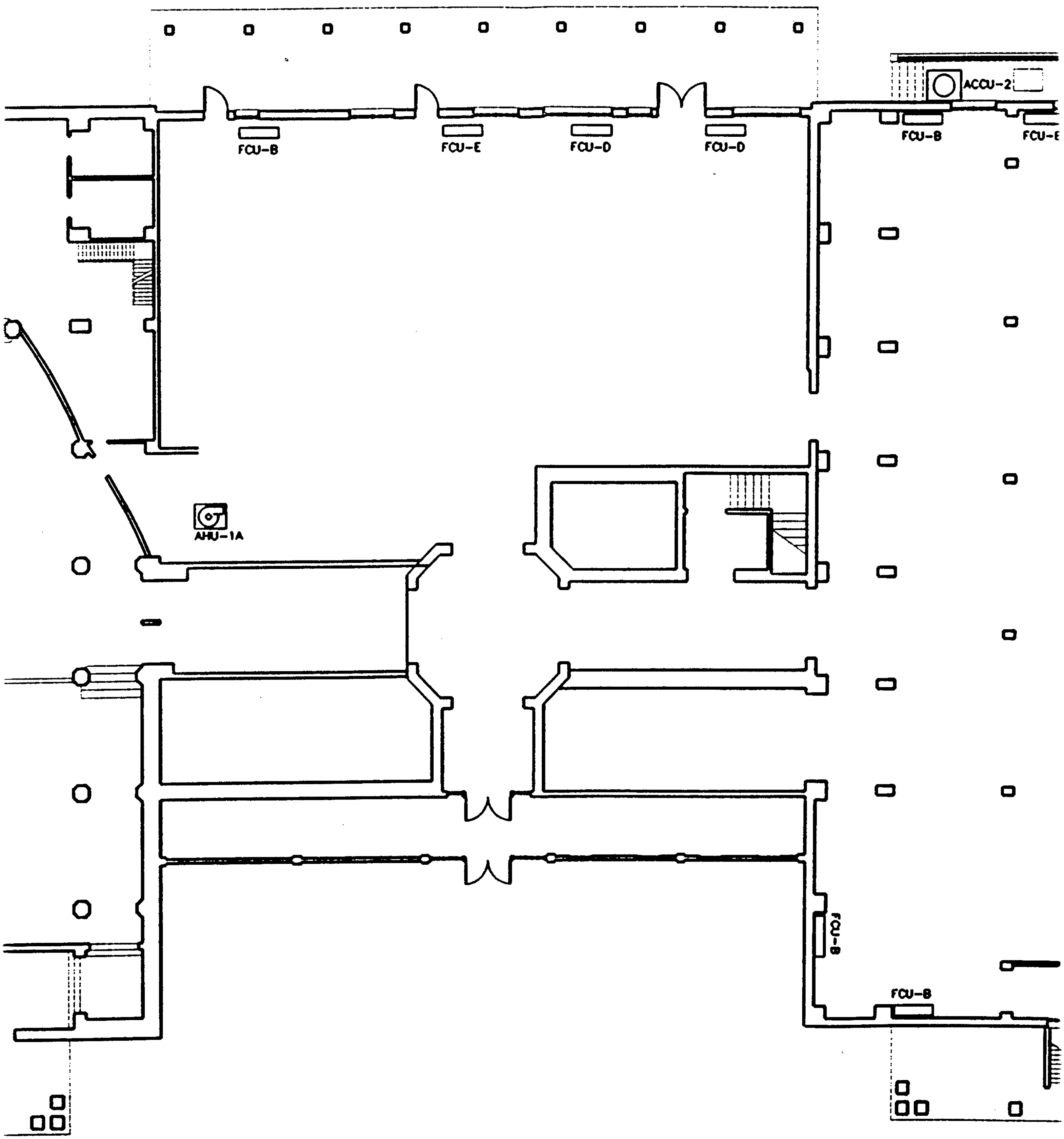
Project No: 60692.00

Designed by:

Drawn by: DLS

1

B6



UDY

Project No: 60692.00

Designed by:

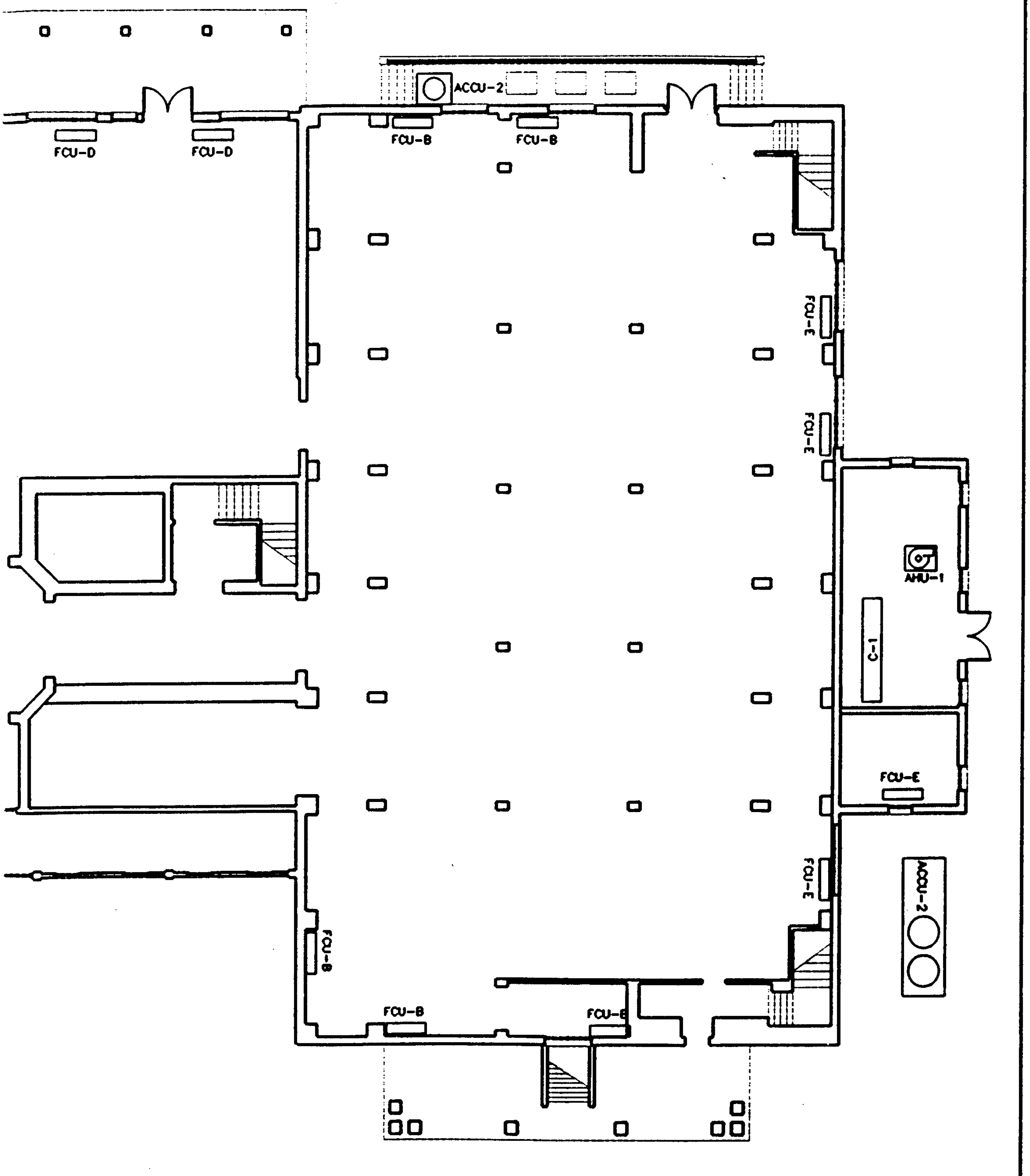
Drawn by: DLS

Title: BUILDING 219 – FIRST FLOOR EQUIPMENT LOCATION PLAN

Modifies Drawing No.:

Scale: 1/16"=1'-0"

2



Title: BUILDING 219 – FIRST FLOOR EQUIPMENT LOCATION PLAN

Date: 14 JULY 94

Sheet No.: 2 of: 3

Modifies Drawing No.:

Scale 1/16"=1'-0"

Drawing No.:

2

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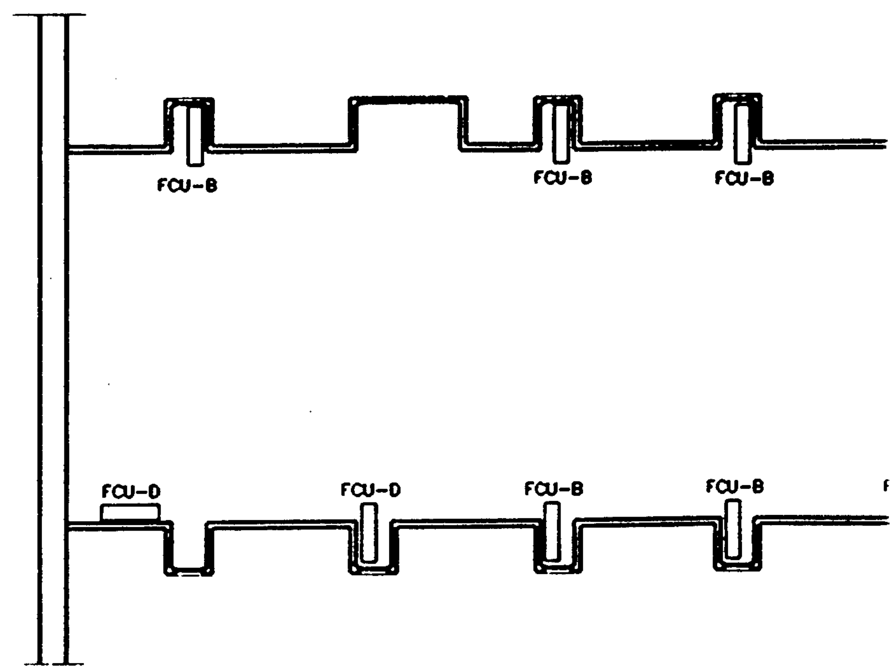
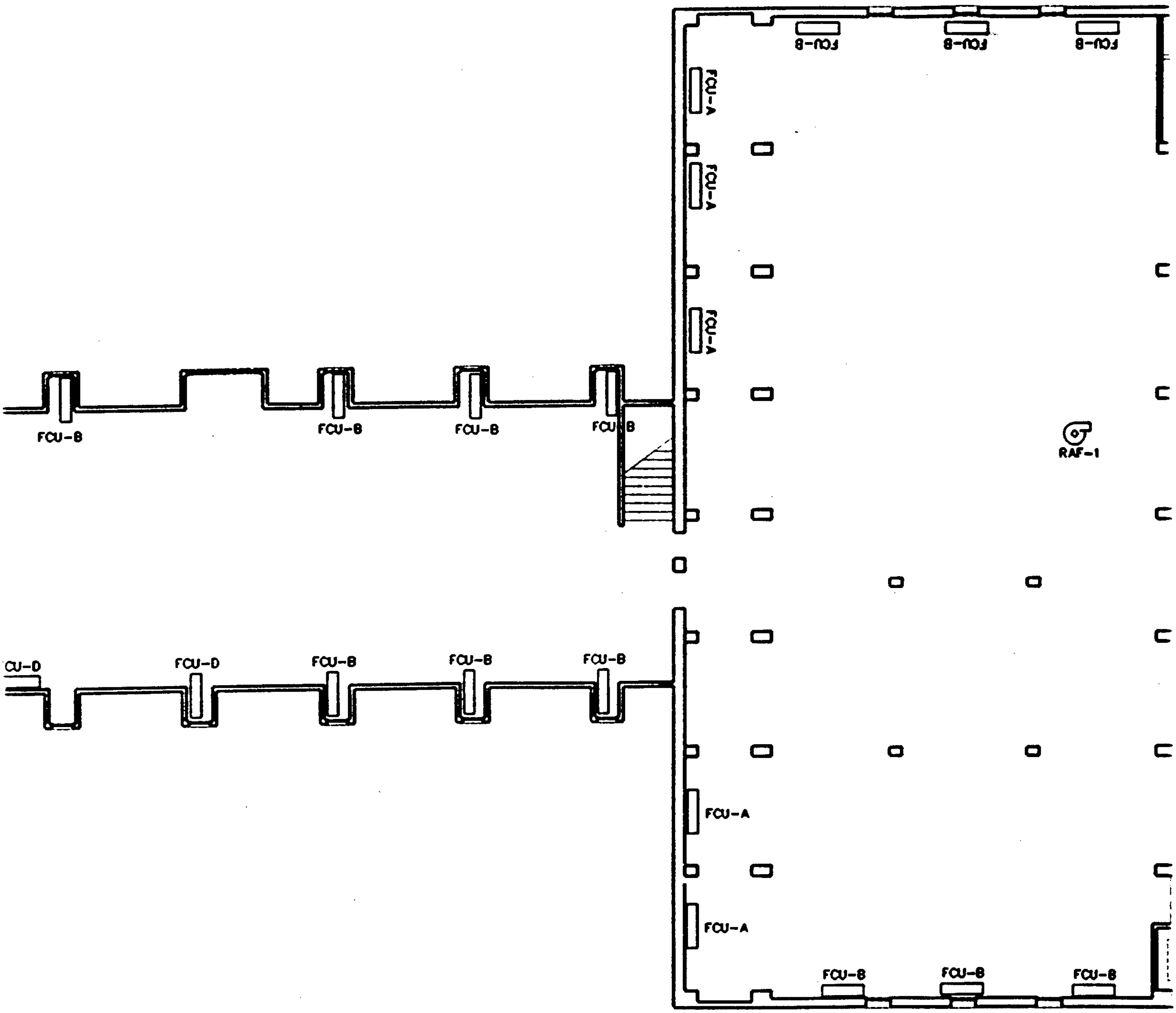


Project: FT. BELVOIR EMS STUDY

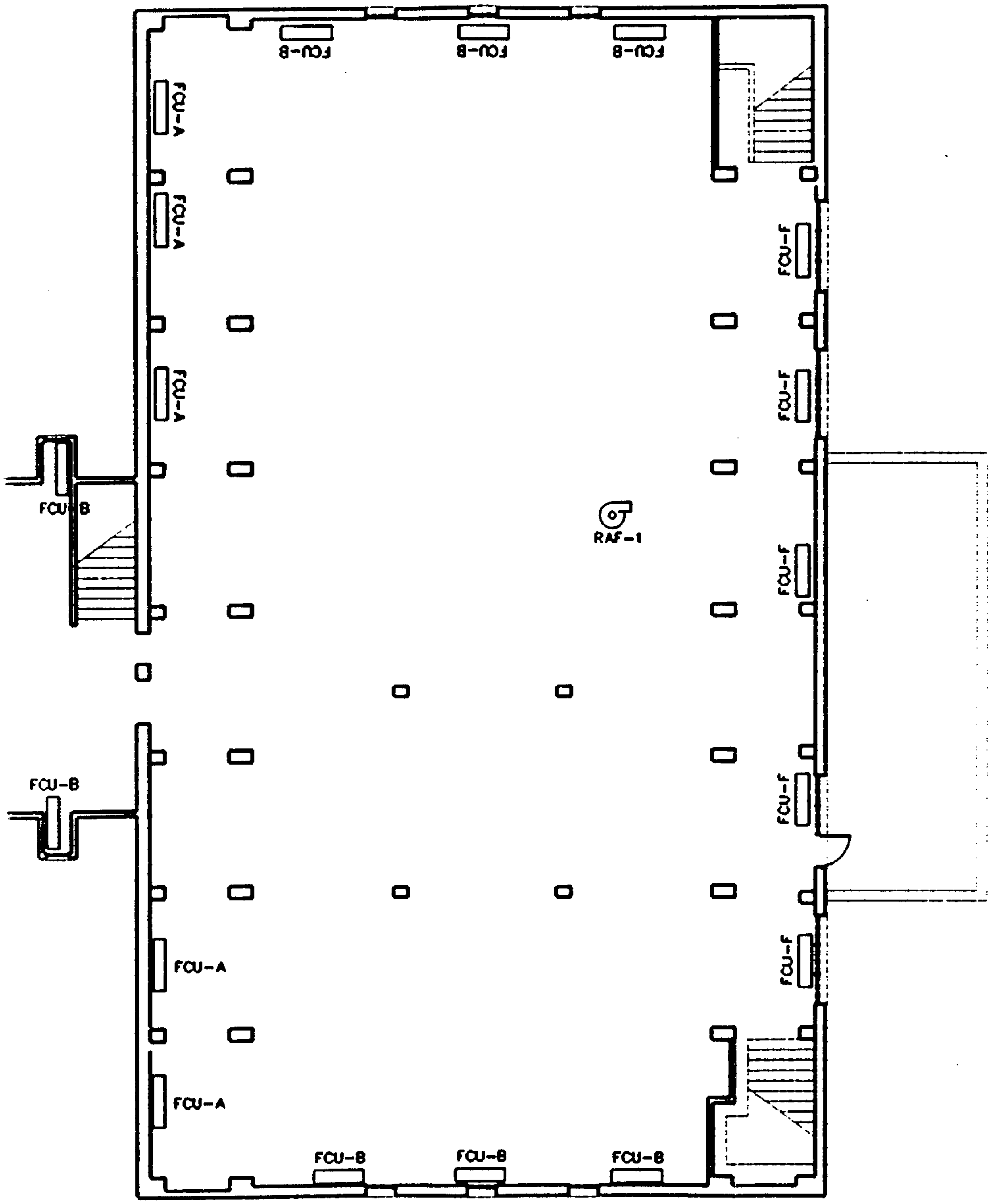
Project No.: 60692.00
Designed by:
Drawn by: DLS
Checked by:

B 7 (1)



STUDY	Project No.: 60692.00	Title: BUILDING 219 – SECOND FLOOR EQUIPMENT LOCATION PLAN
	Designed by:	
	Drawn by: DLS	Modifies Drawing No.: Scale: 1/16"=1'-0"

2



Title: BUILDING 219 – SECOND FLOOR EQUIPMENT LOCATION PLAN

Date: 14 JULY 94

Sheet No.: 3 of 3

Modifies Drawing No.:

Scale: 1/16"=1'-0"

Drawing No. 3

BUILDING 247

B-8

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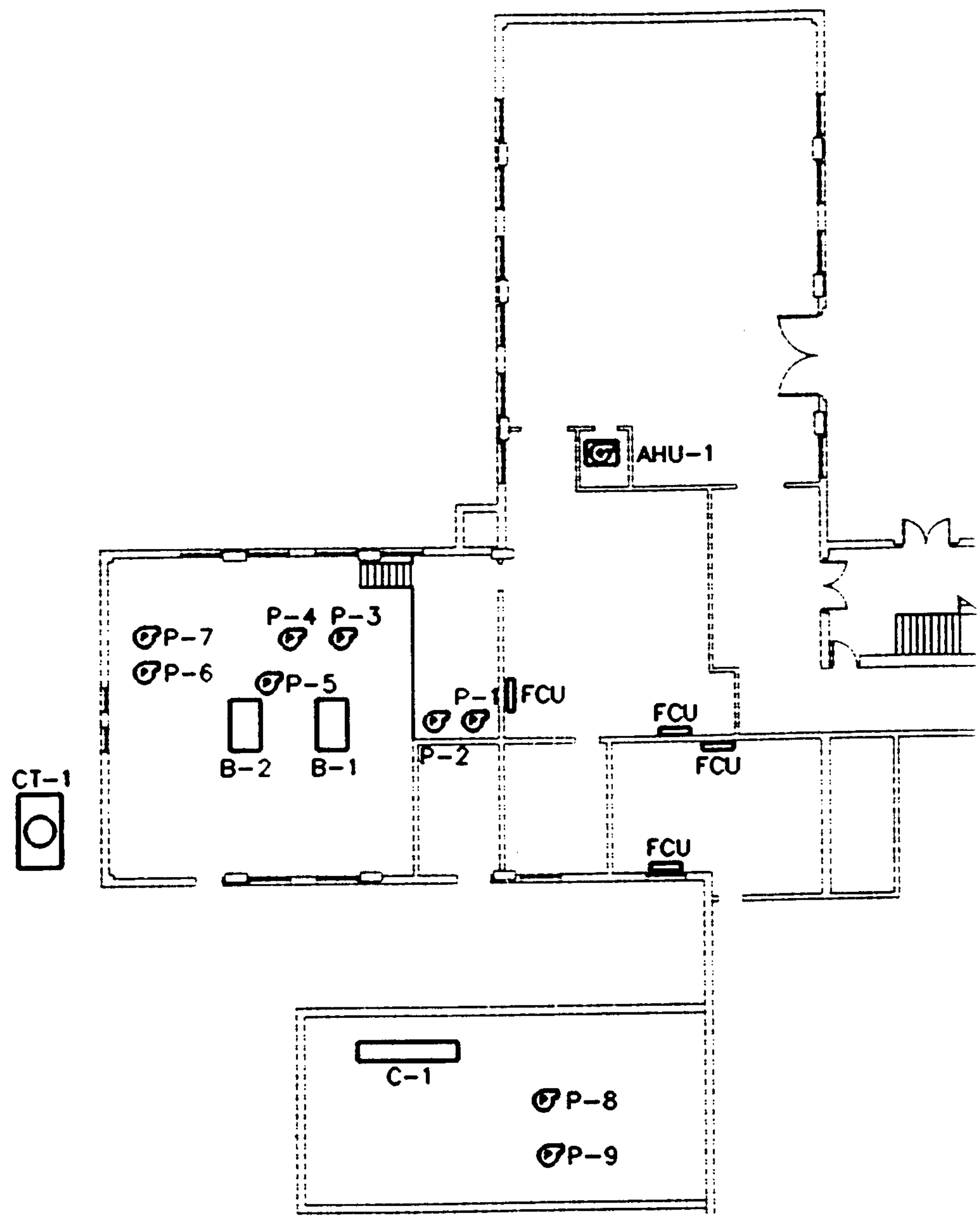
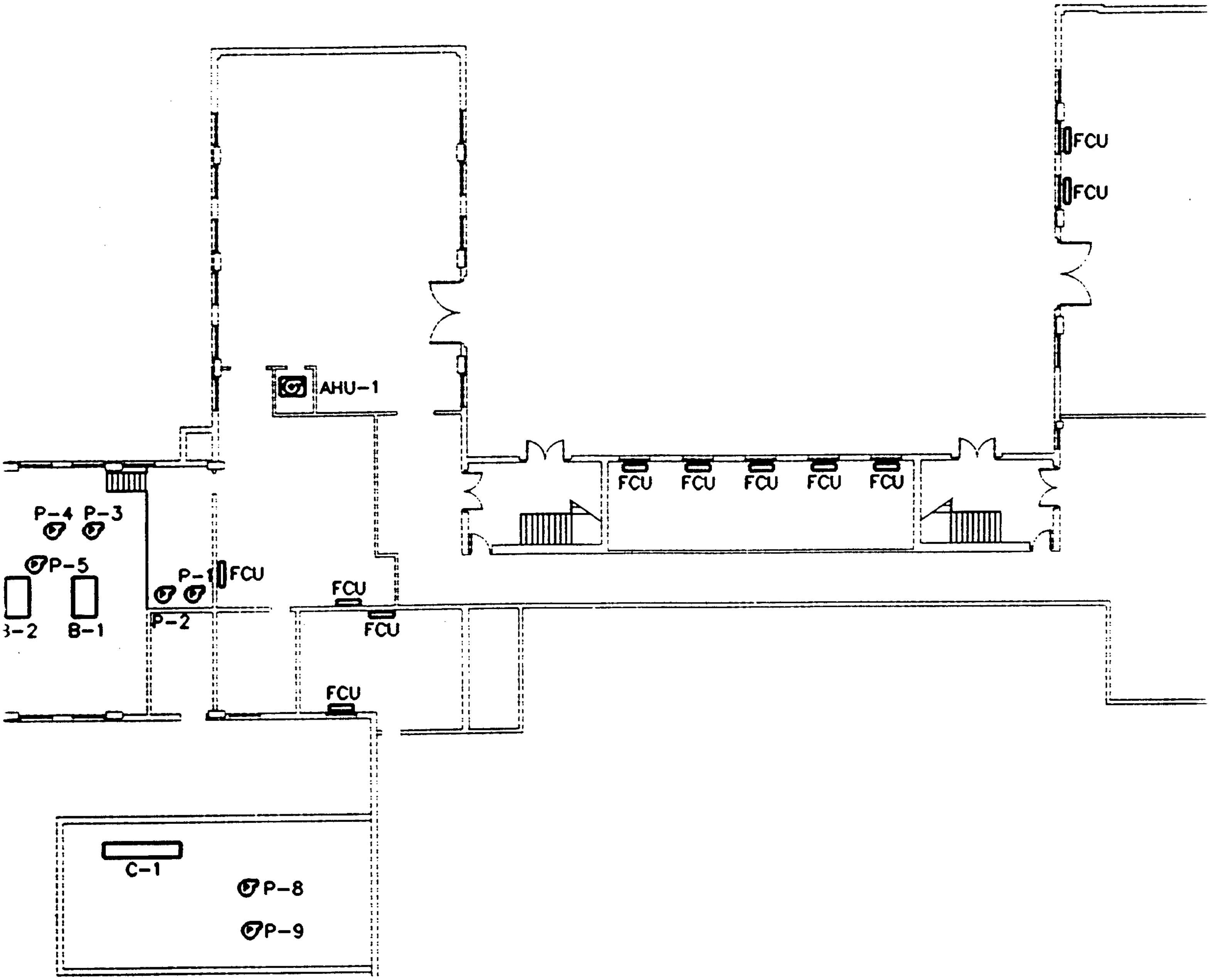


Project: FT. BELVOIR EMS STUDY
Project No.: 60692.00
Designed by:
Drawn by: FE/DS

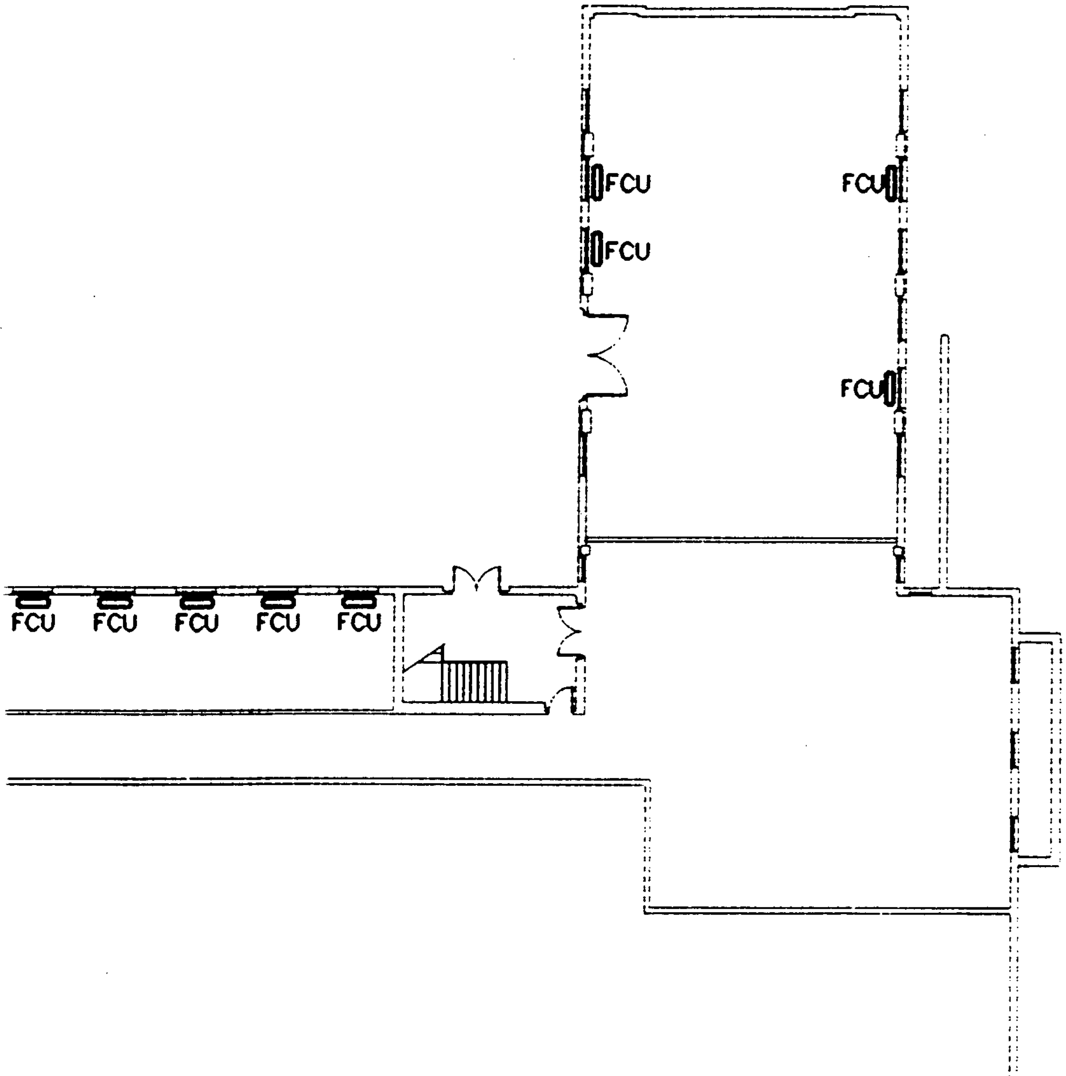
1 B-9



Project No.: 60692.00	Title: BUILING 247 - BASEMENT LEVEL EQUIPMENT LOCATION PLAN	
Designed by:		
Drawn by: FE/DS	Modifies Drawing No.	Scale: NONE

B-9

(2)



tle: BUILING 247 – BASEMENT LEVEL
EQUIPMENT LOCATION PLAN

Date: 14 JULY 94
Sheet No.: 1 of 5

odifies Drawing No. ______ Scale: NONE Drawing No.: ______

(3)

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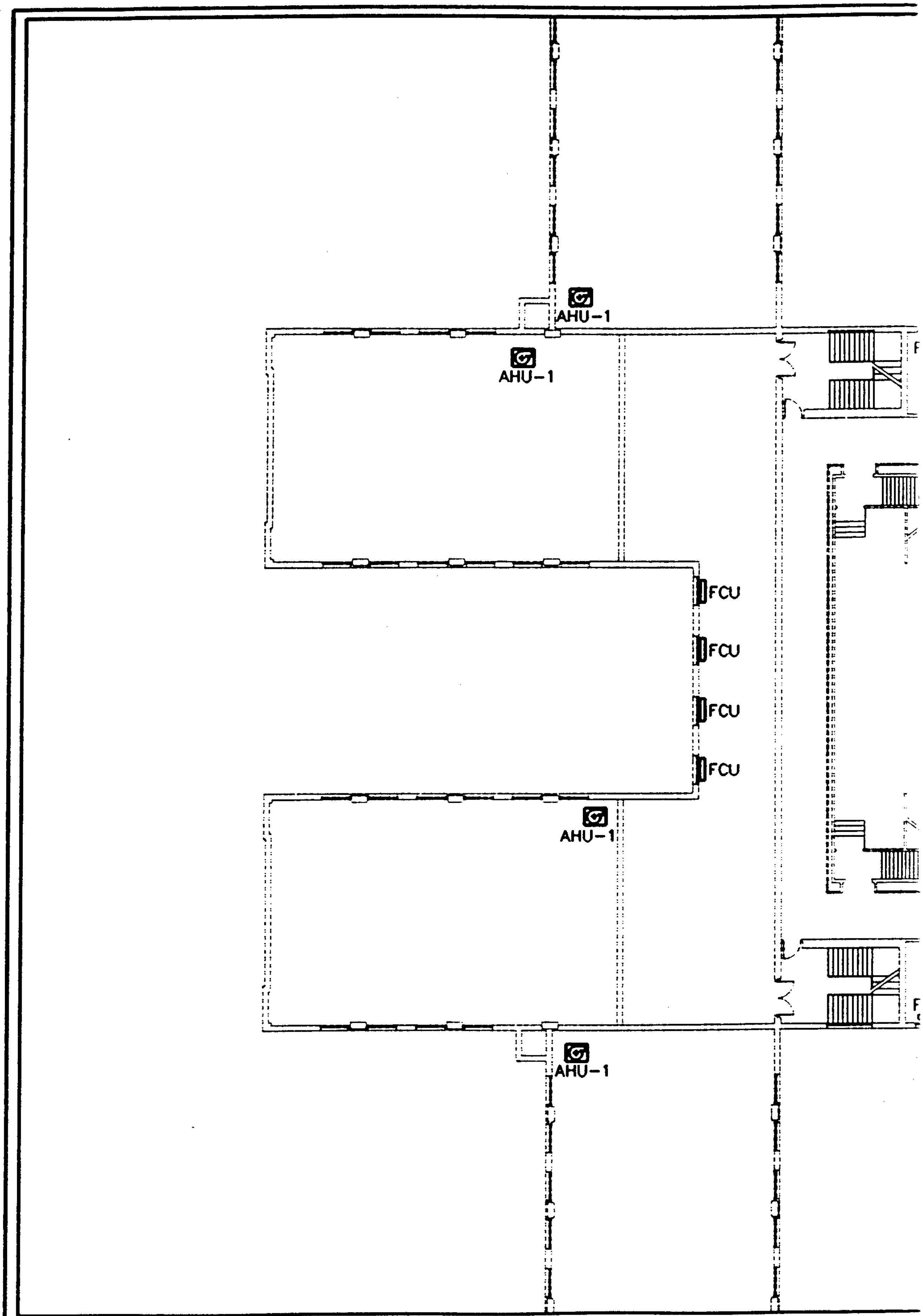
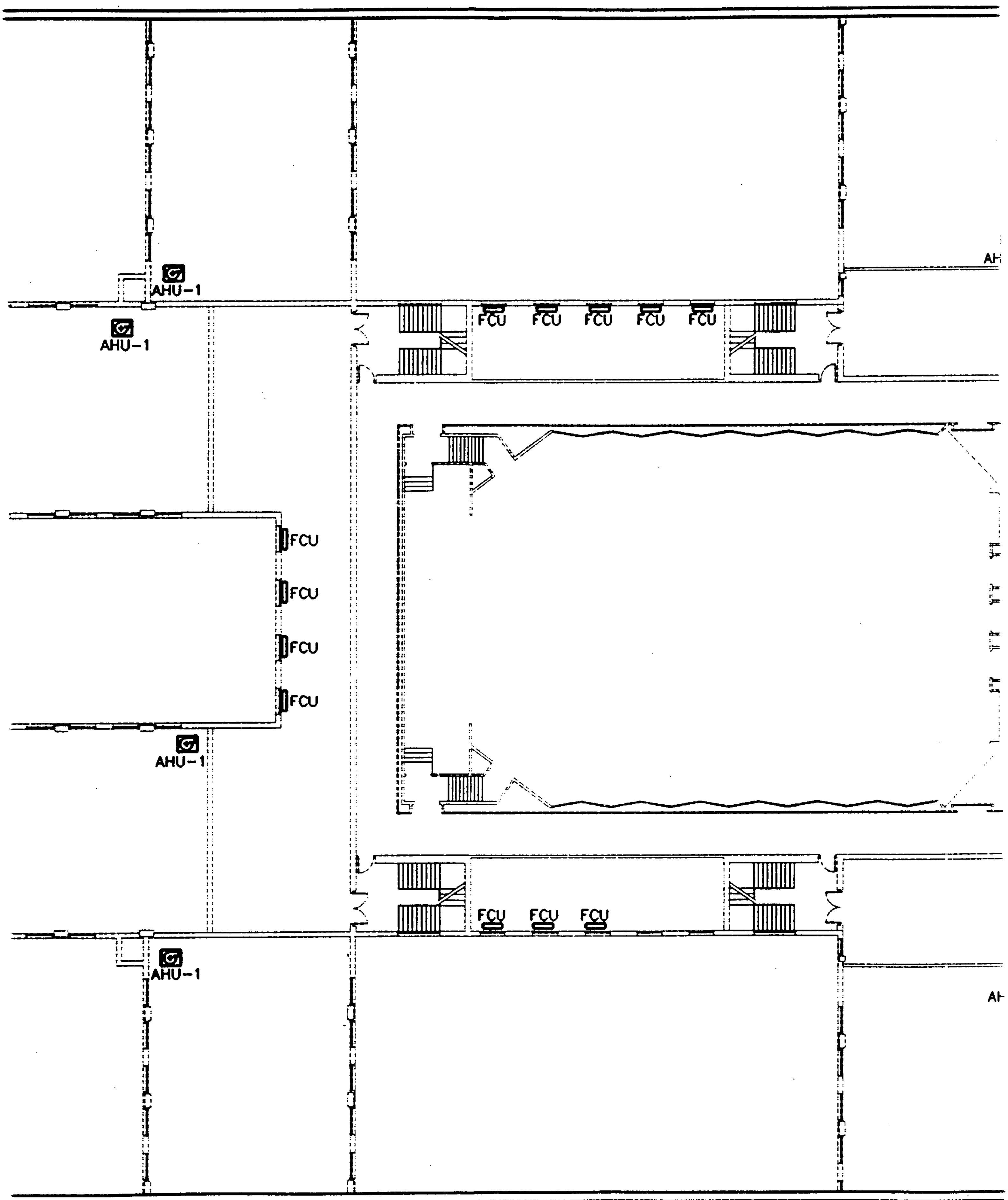


Project: FT. BELVOIR EMS STUDY

Project No.: 60692.00

Designed by:

Drawn by: FE/DS



Project No.: 60692.00

Designed by:

Drawn by: FE/DS

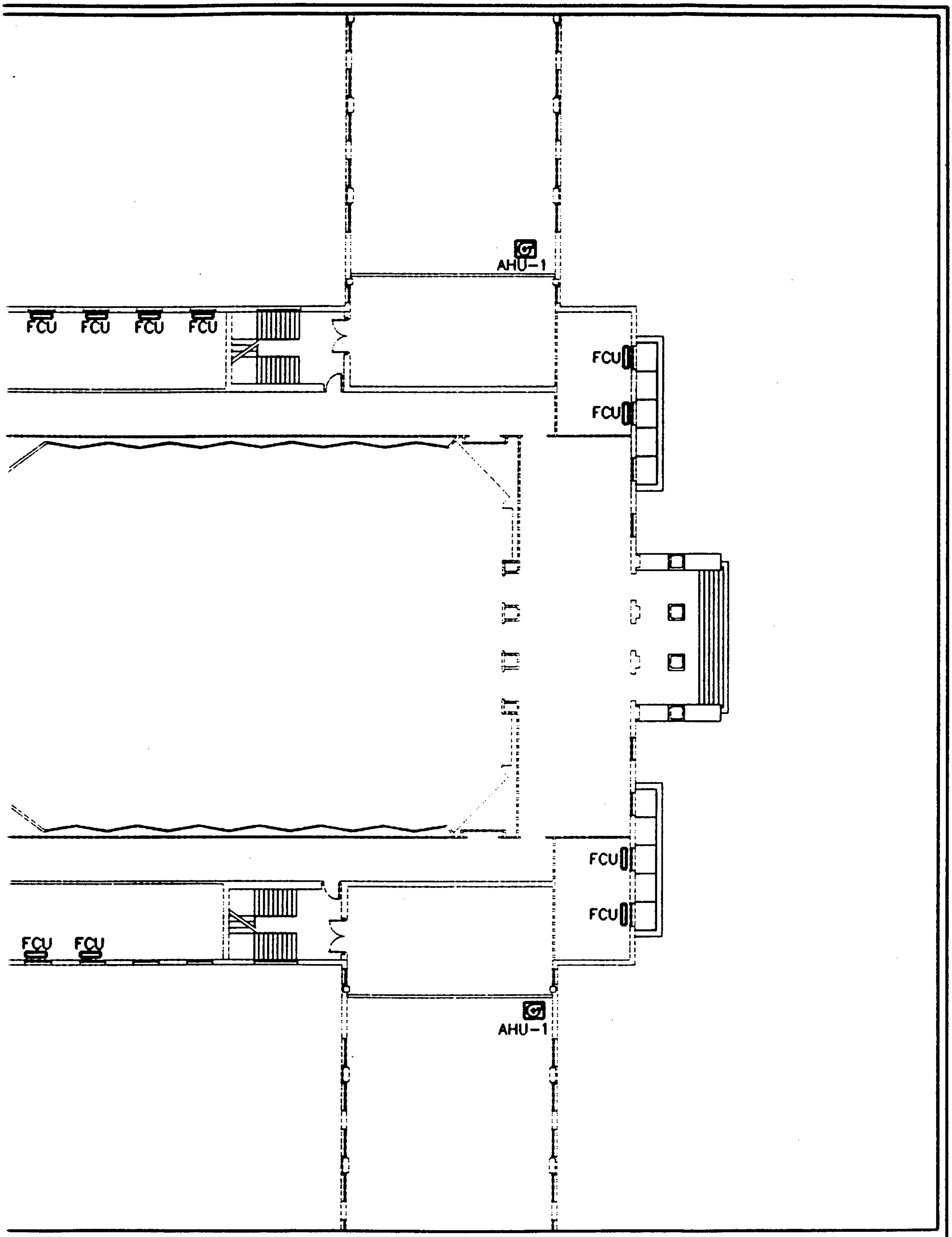
Title: BUILDING 247 – FIRST FLOOR EQUIPMENT LOCATION PLAN

Modifies Drawing No.:

Scale: NONE

(2)

B-10



BUILDING 247 - FIRST FLOOR
EQUIPMENT LOCATION PLAN

Date: 14 JULY 94
Sheet No.: 2 of: 5

s Drawing No.: Scale: NONE Drawing No.:

3

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THE FLOUR MILL
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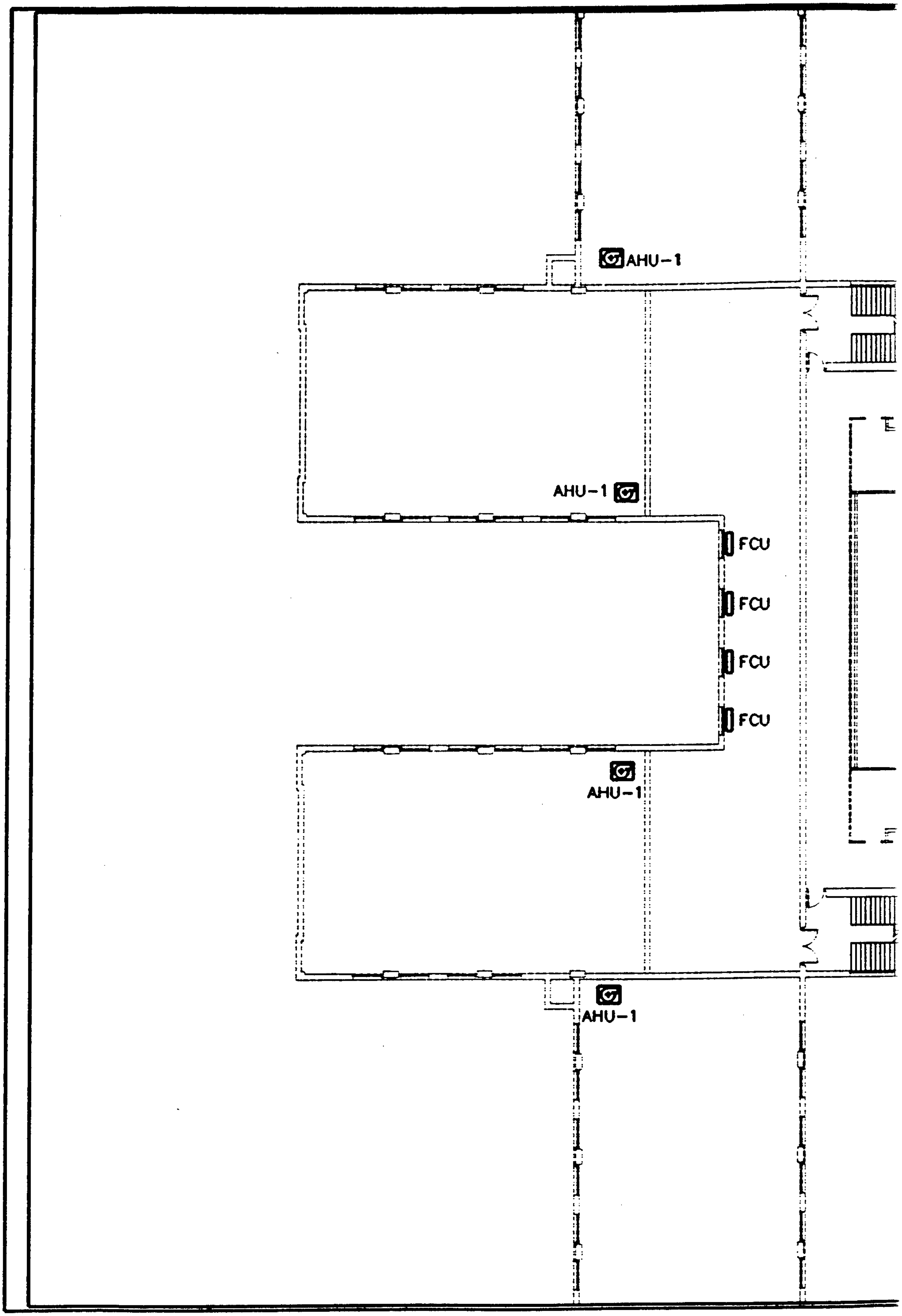
WASHINGTON, DC 20007
TEL (202) 471-5000



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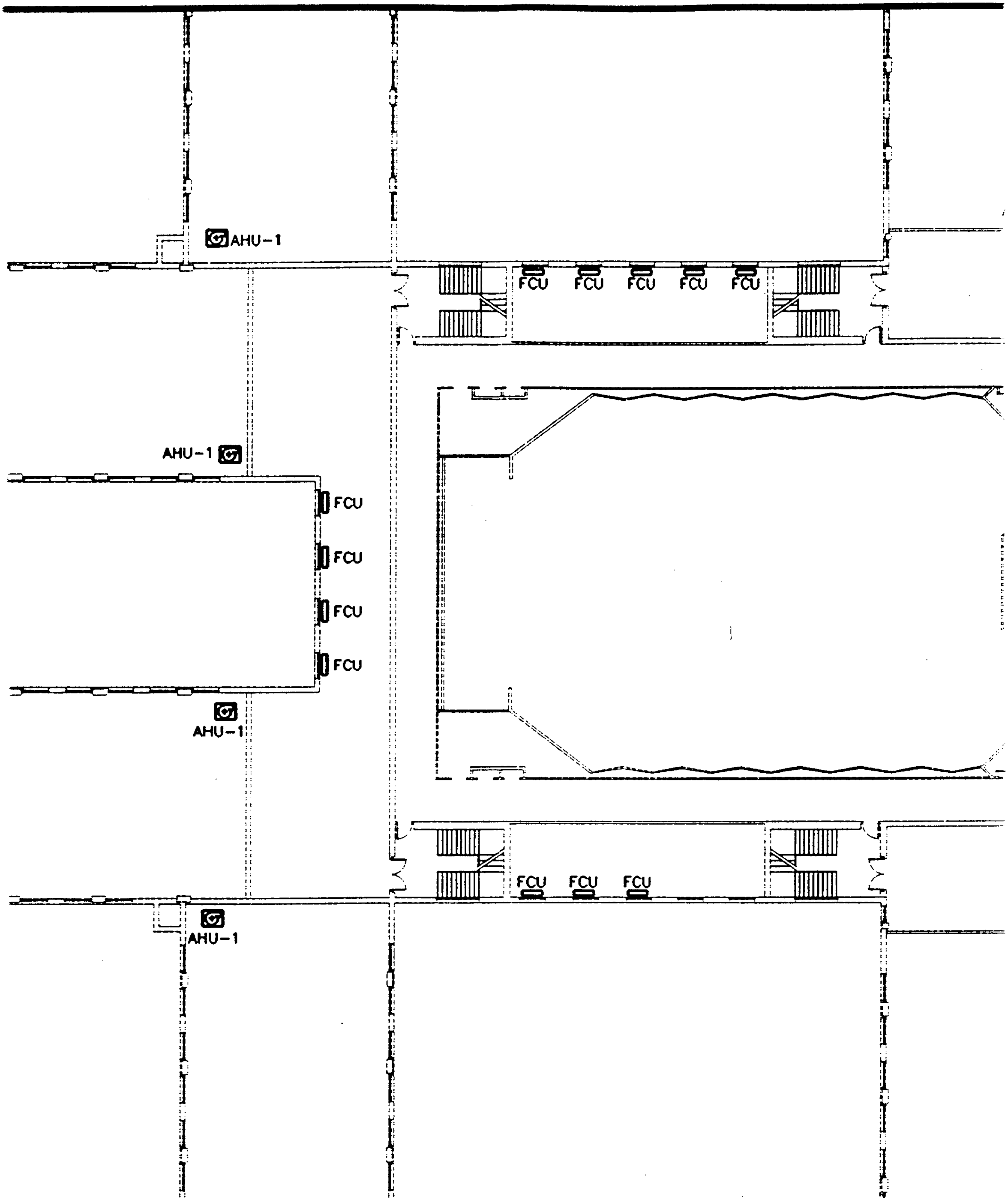
Project No.: 60692.00
Designed by:
Drawn by: FE/DS



Project No.: 60692.00

Designed by:

Drawn by: FE/DS

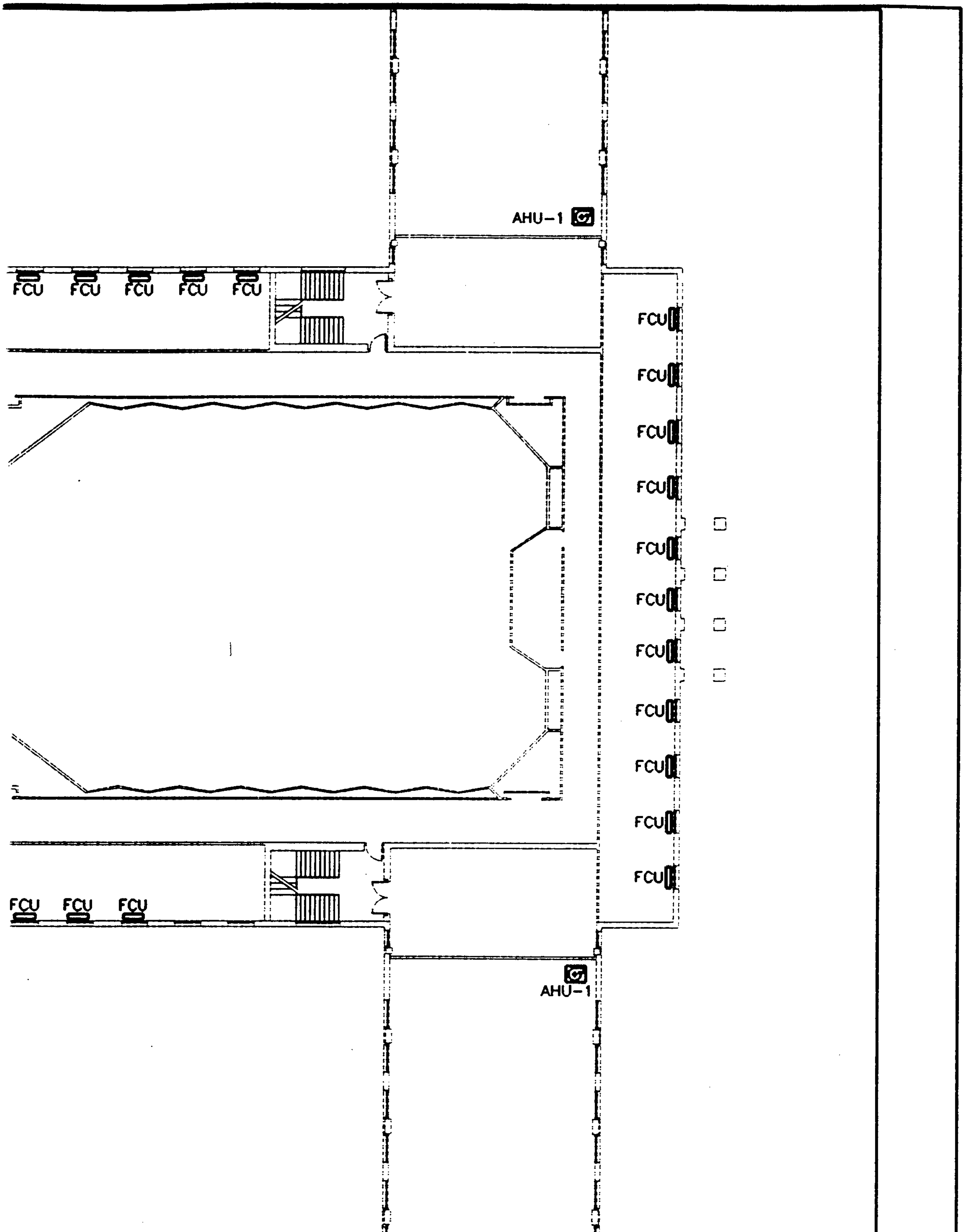
Title: BUILDING 247 – SECOND FLOOR
MECHANICAL EQUIPMENT LOCATION PLAN

Modifies Drawing No.:

Scale: NONE

B-11

2



BUILDING 247 – SECOND FLOOR
MECHANICAL EQUIPMENT LOCATION PLAN

Date: 14 JULY 94
Sheet No.: 3 of: 5

ies Drawing No.: Scale: NONE Drawing No.:

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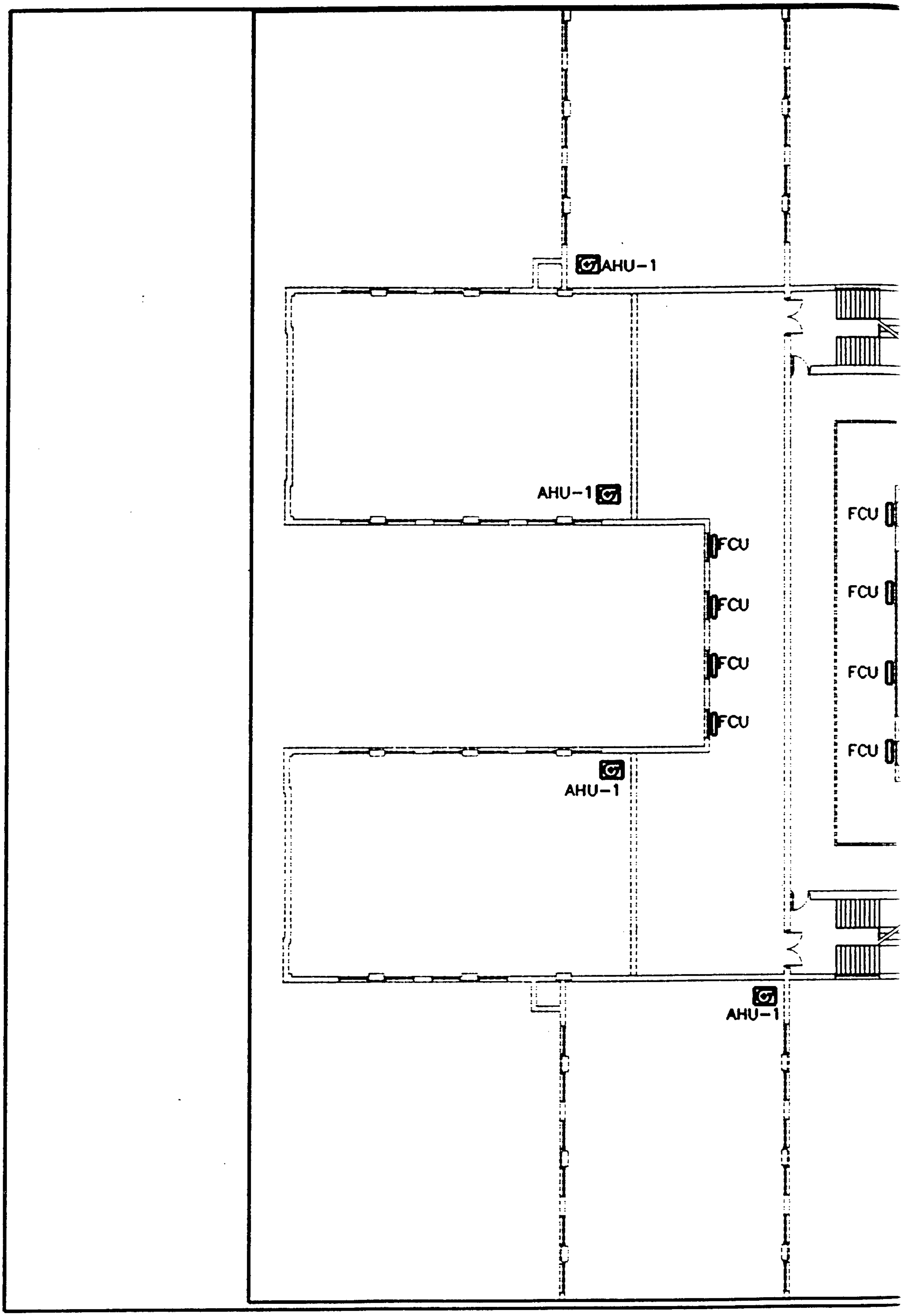

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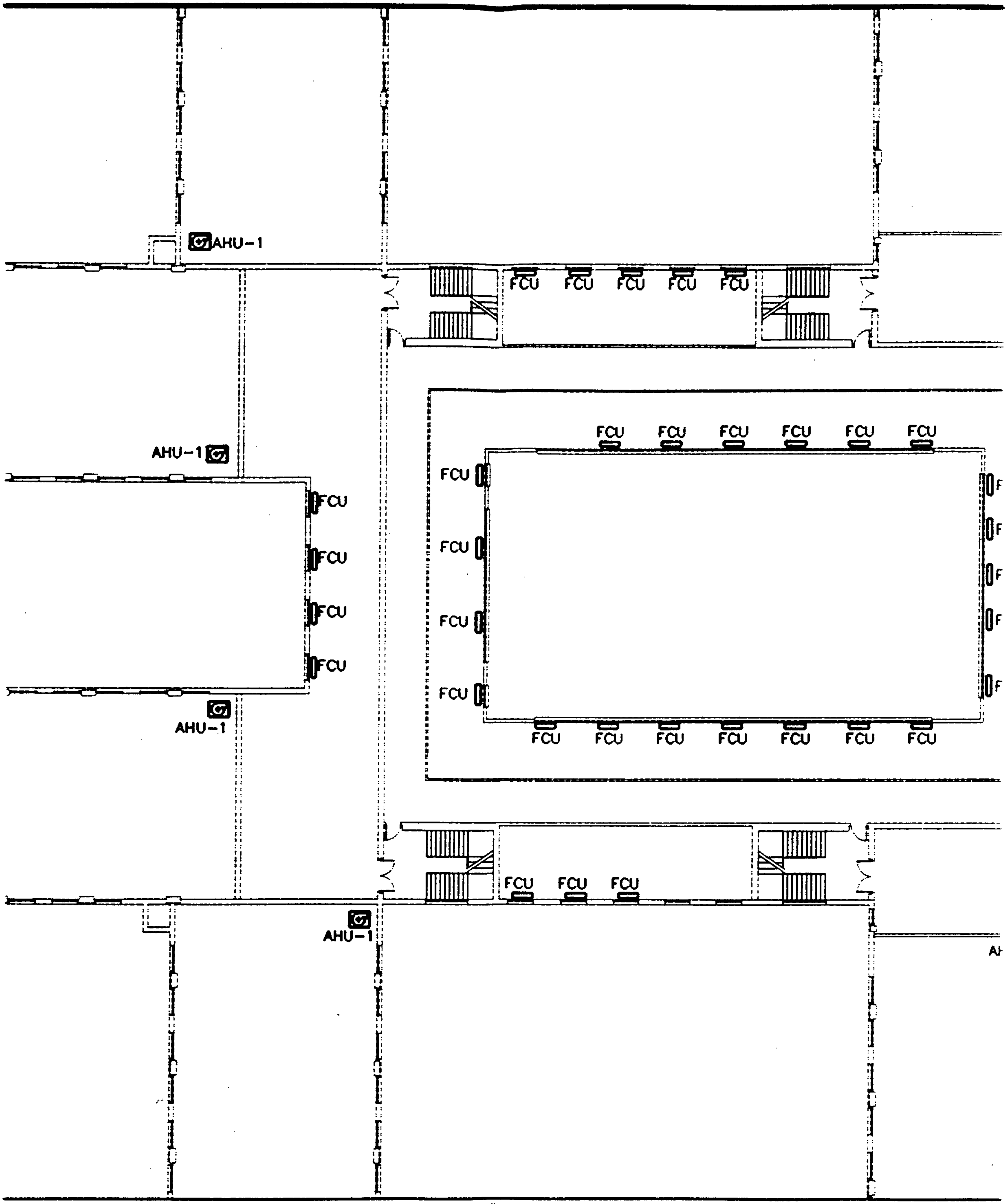
Project No.: 60692.00
Designed by:
Drawn by: FE/DS



Project No.: 60692.00

Designed by:

Drawn by: FE/DS

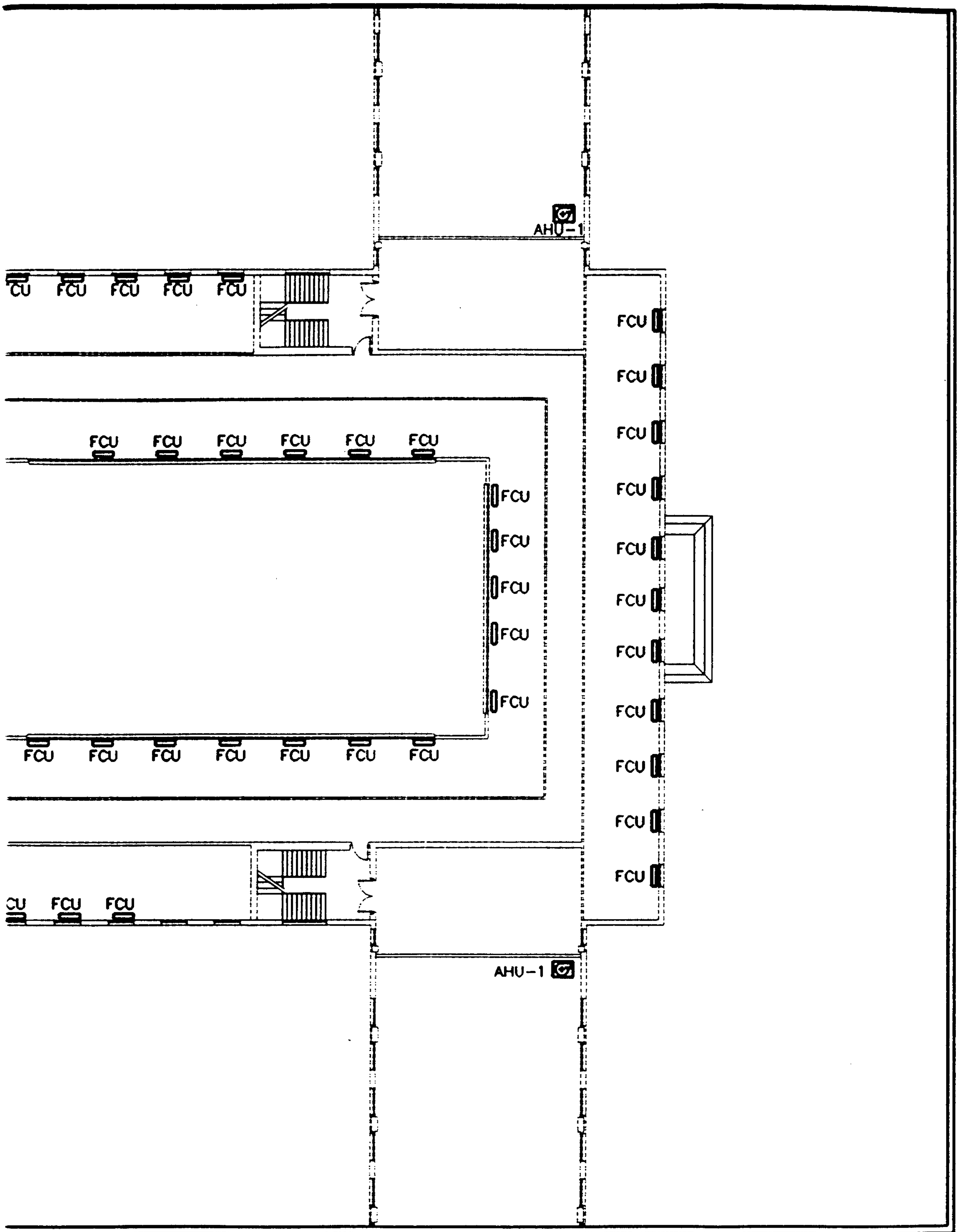
Title: BUILDING 247 – THIRD FLOOR MECHANICAL EQUIPMENT LOCATION PLAN

Modifies Drawing No

Scale: NONE

B-12

2



BUILDING 247 – THIRD FLOOR
MECHANICAL EQUIPMENT LOCATION PLAN

Date: 14 JULY 94
Sheet No.: 4 of: 5

ifies Drawing No

Scale: NONE

Drawing No.:

(3)

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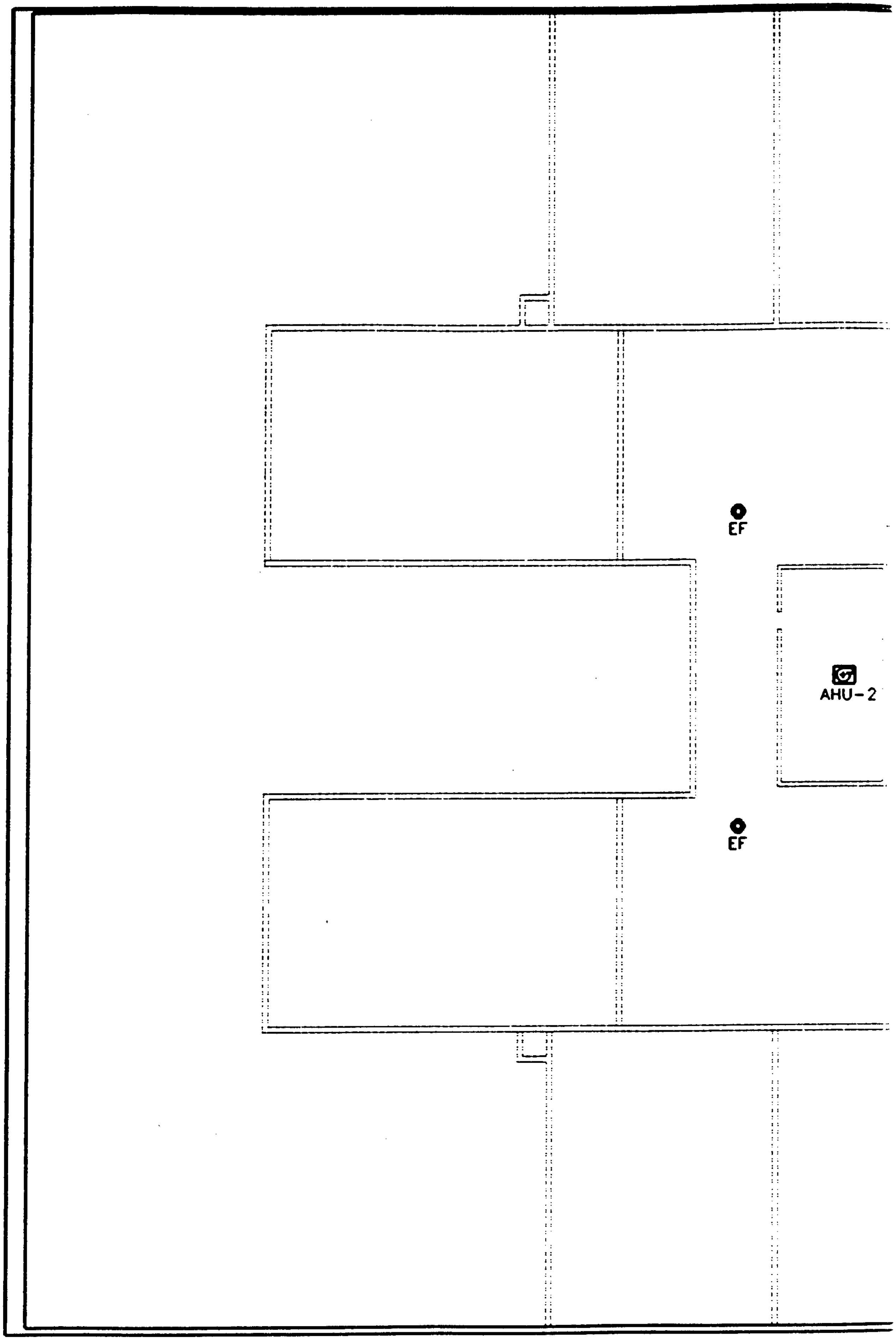

Project: FT. BELVOIR EMS STUDY

Project No.: 60692.00

Designed by:

Drawn by: FE/DS

Checked by:

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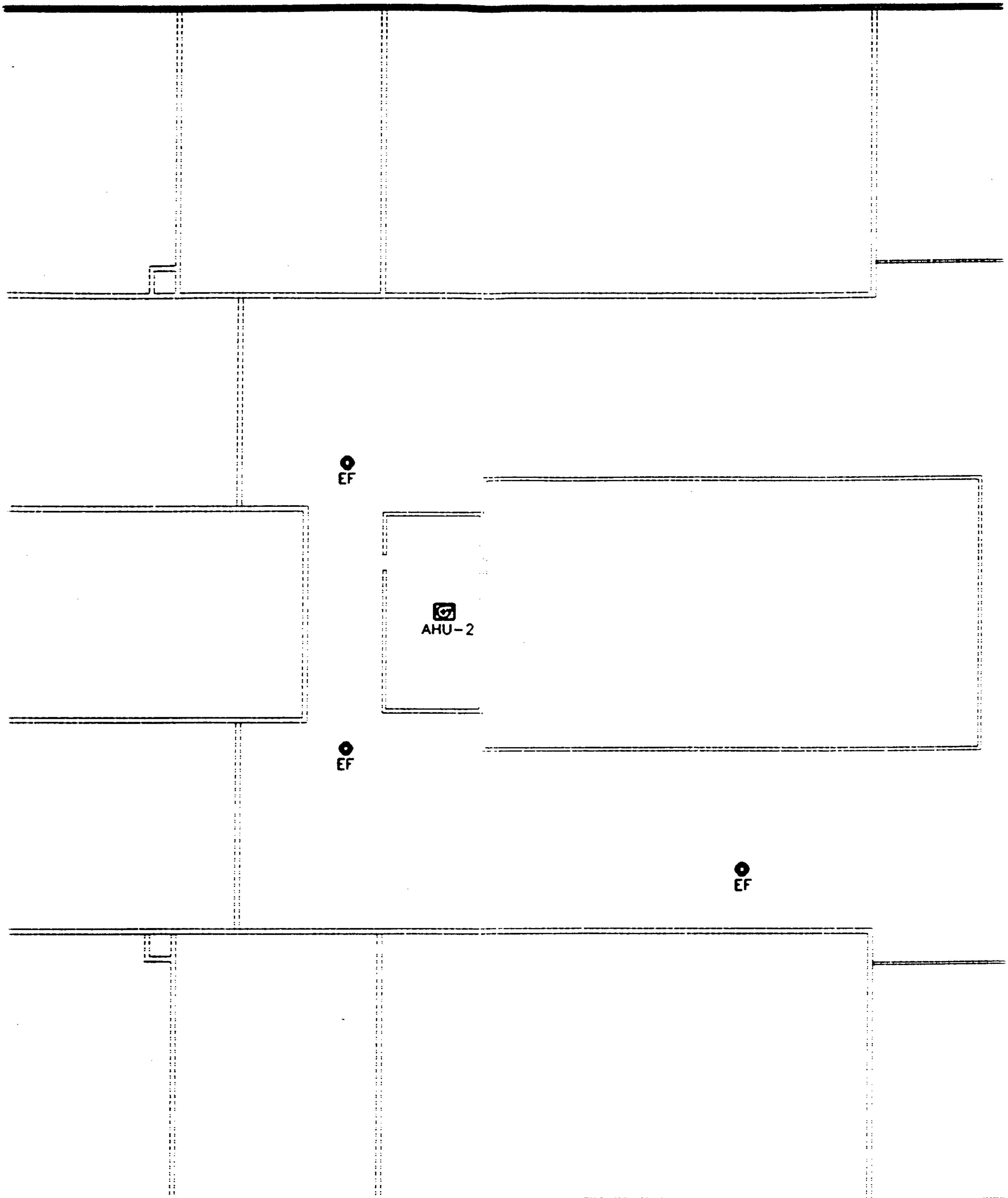

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Project No.: 60692.00

Title: BUILDING 247 – ROOF MECHANICAL EQUIPMENT LOCATION PLAN

Designed by:

Drawn by: FE/DS

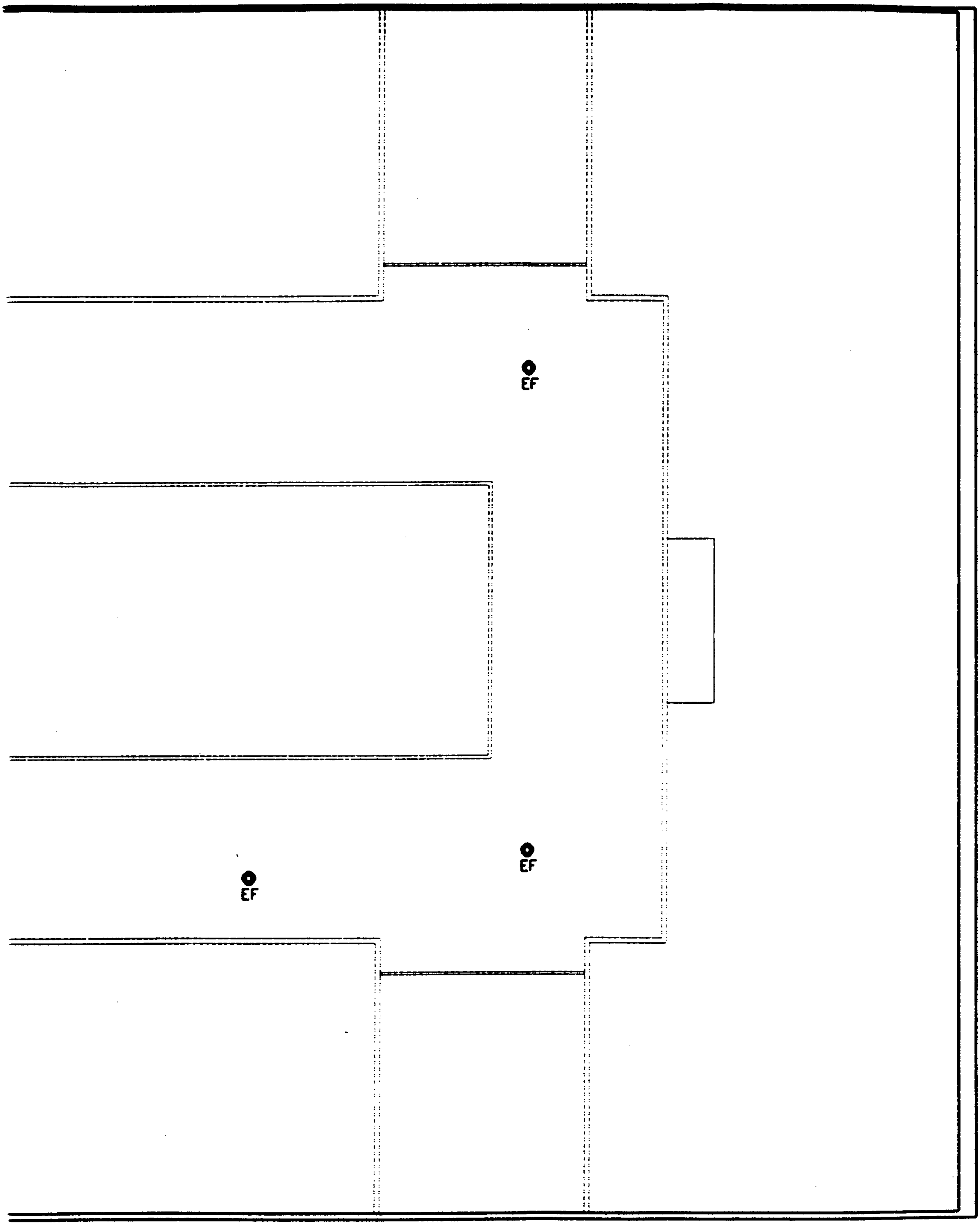
2

Modifies Drawing No.:

Scale NONE

Checked by:

B-13



Title: BUILDING 247 – ROOF MECHANICAL EQUIPMENT LOCATION PLAN

Date: 14 JULY 94

Sheet No.: 5 of: 5

Modifies Drawing No.:

Scale: NONE

Drawing No.:

3

BUILDING 1425

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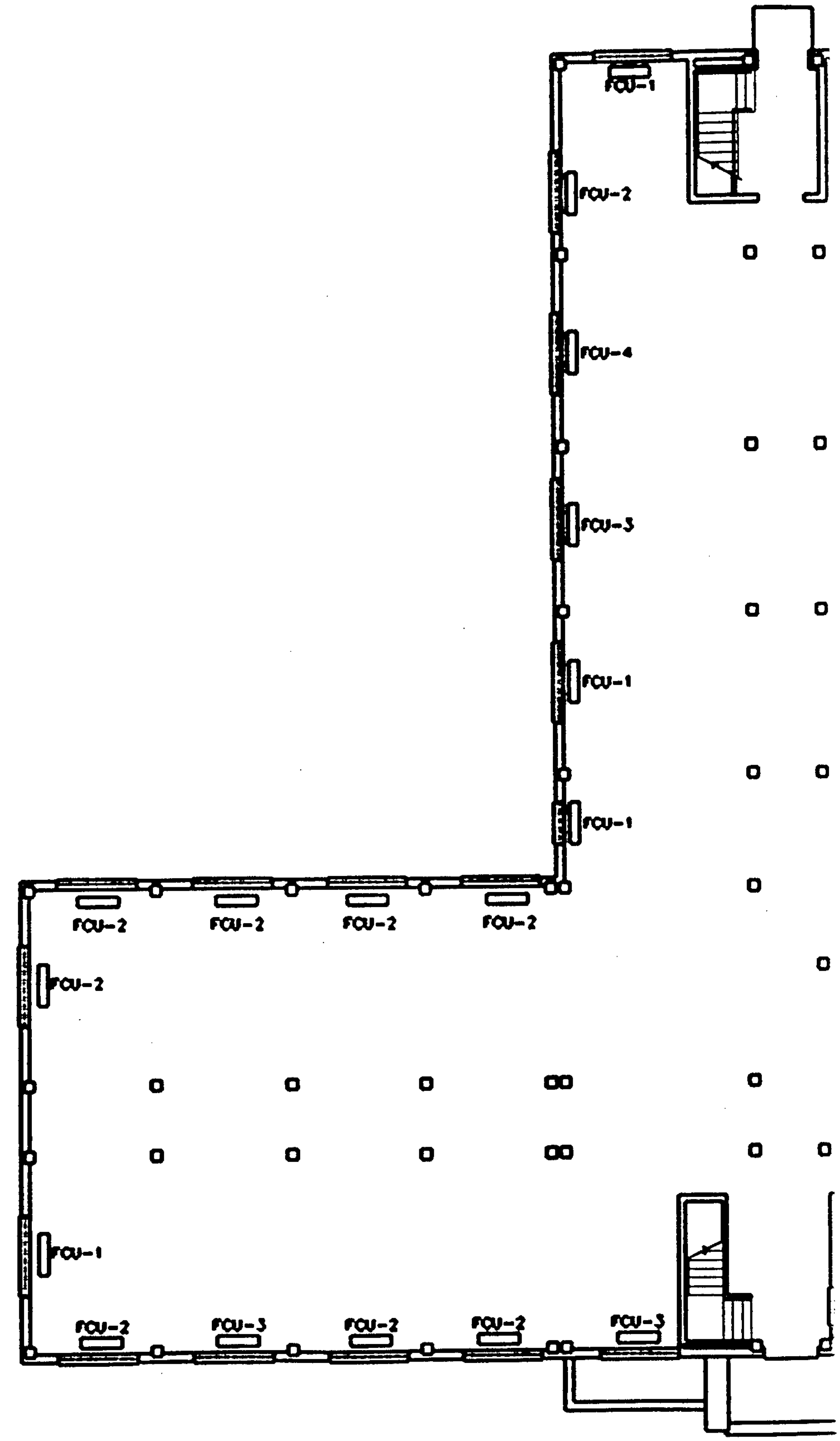
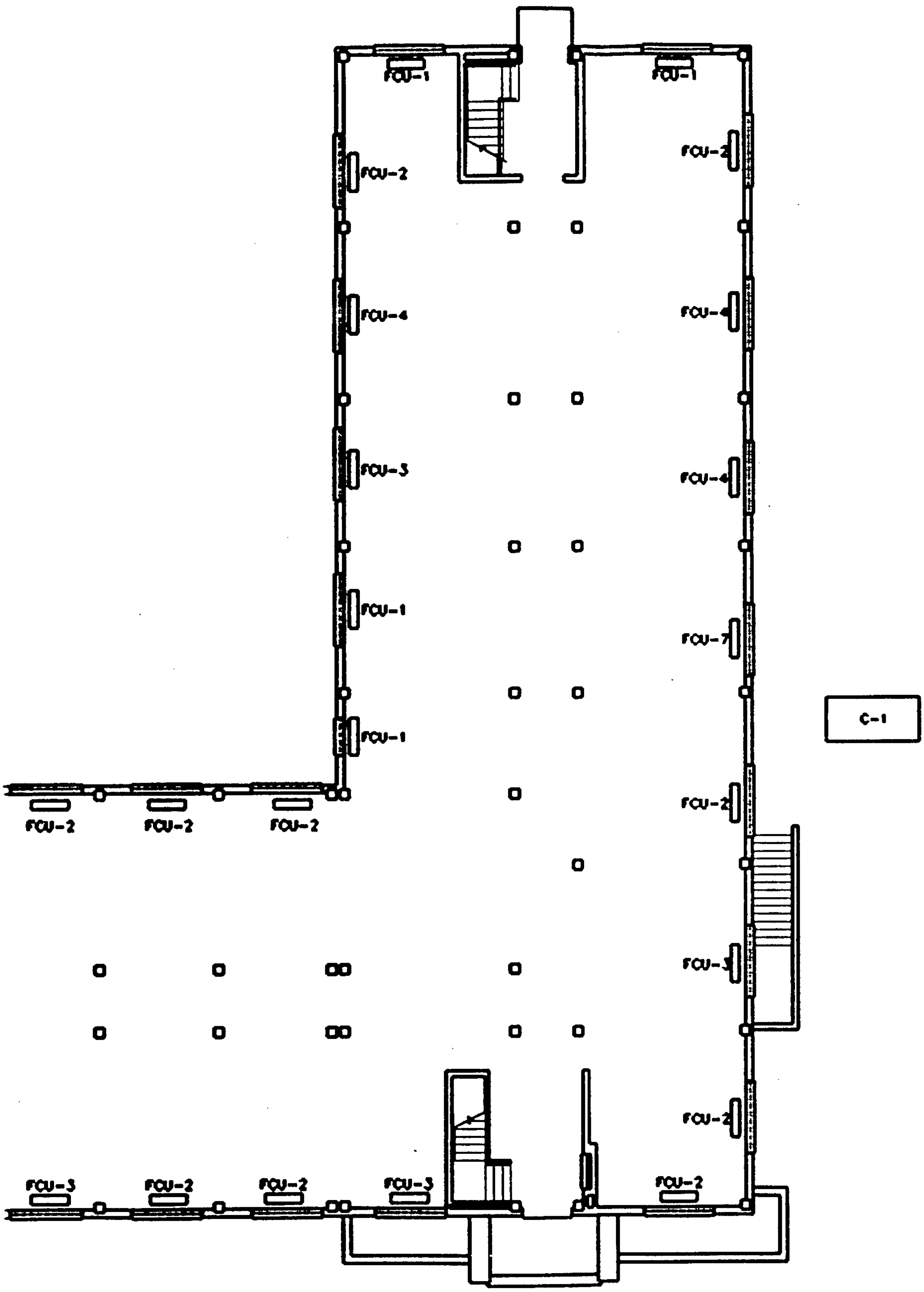


Project: FT. BELVOIR EMS STUDY

Project No.: 60692.00
Designed by:
Drawn by: FE/DLS



Project No.: 60692.00

Designed by:

Drawn by FE/DLS

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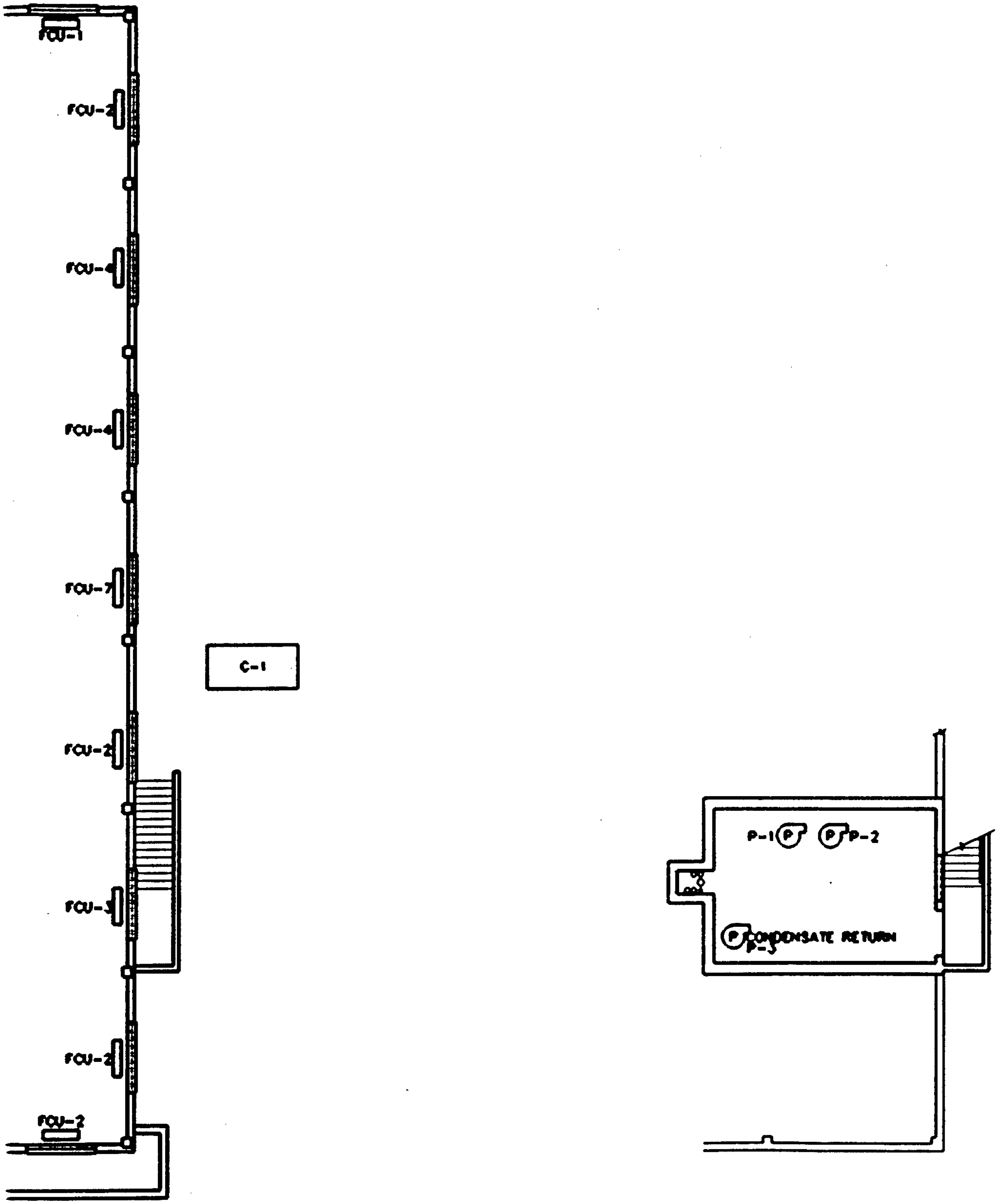
Title: BUILDING 1425 – BASEMENT & FIRST F
MECHANICAL EQUIPMENT LOCATION PLA

Modifies Drawing No.

Scale: 1/16" = 1'-

B-15



BASEMENT PART PLAN

tle: BUILDING 1425 – BASEMENT & FIRST FLOOR Date: 14 JULY 94
MECHANICAL EQUIPMENT LOCATION PLAN Sheet No.: 1 of 2
odifies Drawing No. ______ Scale: 1/16" = 1'-0" Drawing No.: ______

3

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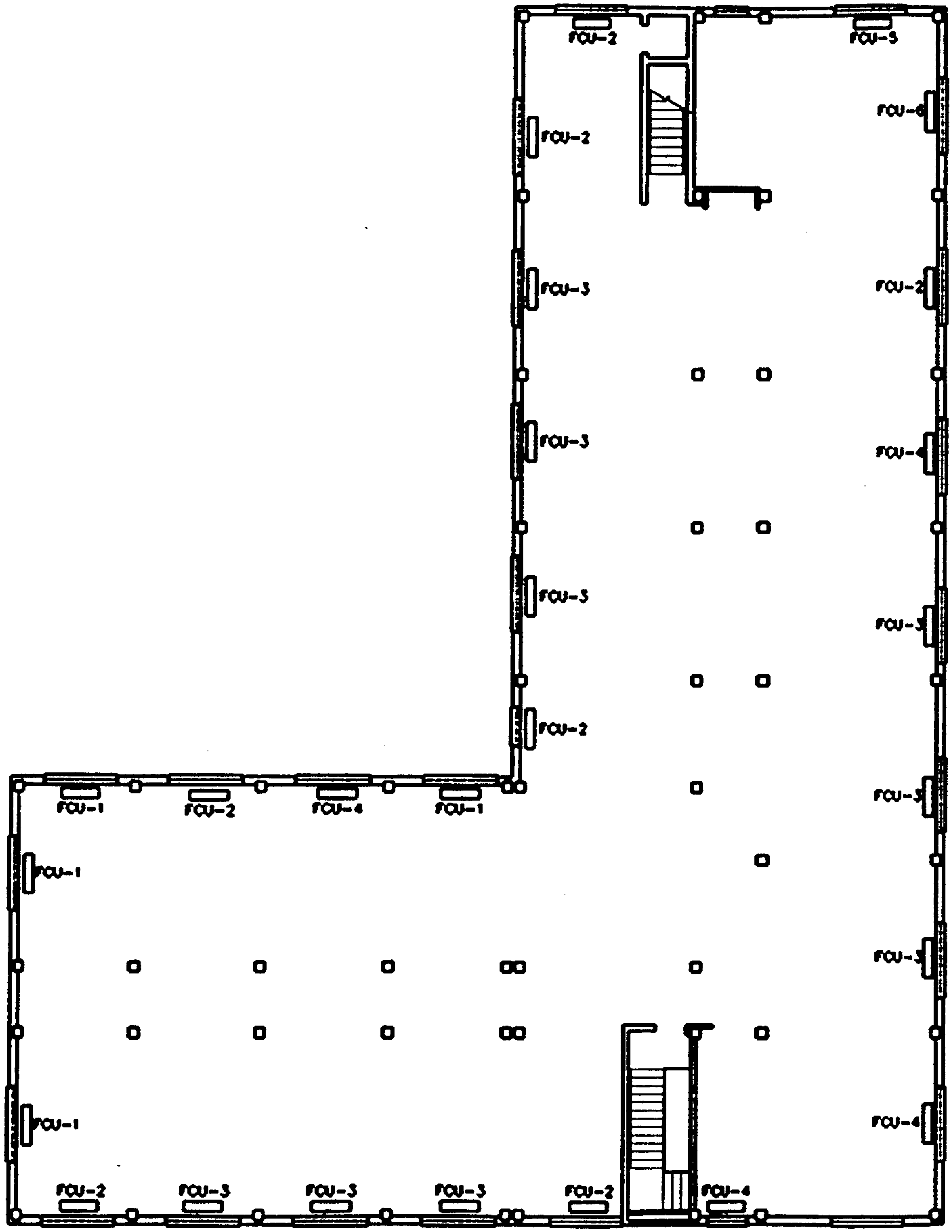
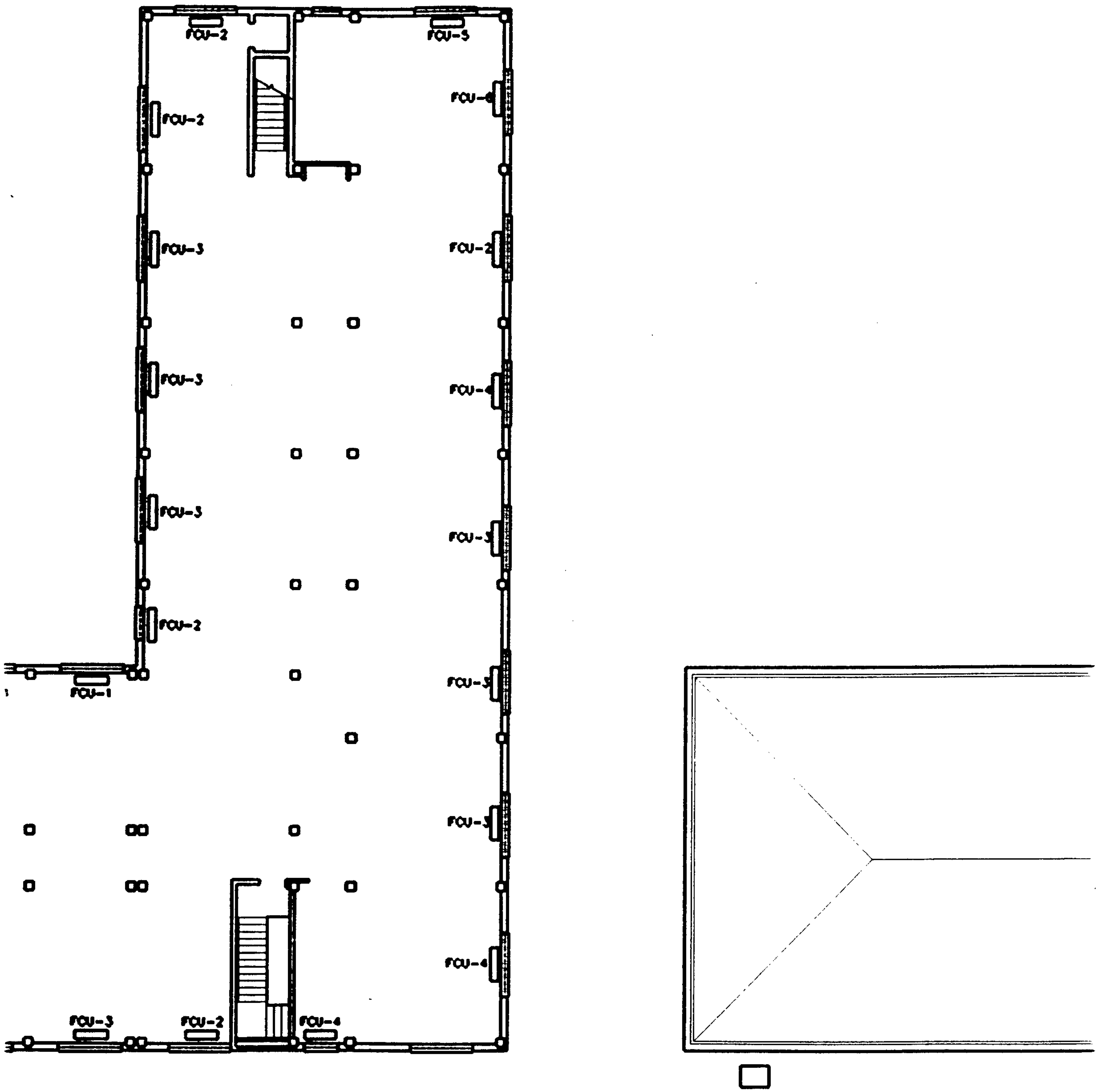


Project: FT. BELVOIR EMS STUDY

Project No.: 60692.00

Designed by:

Drawn by: FE/DLS



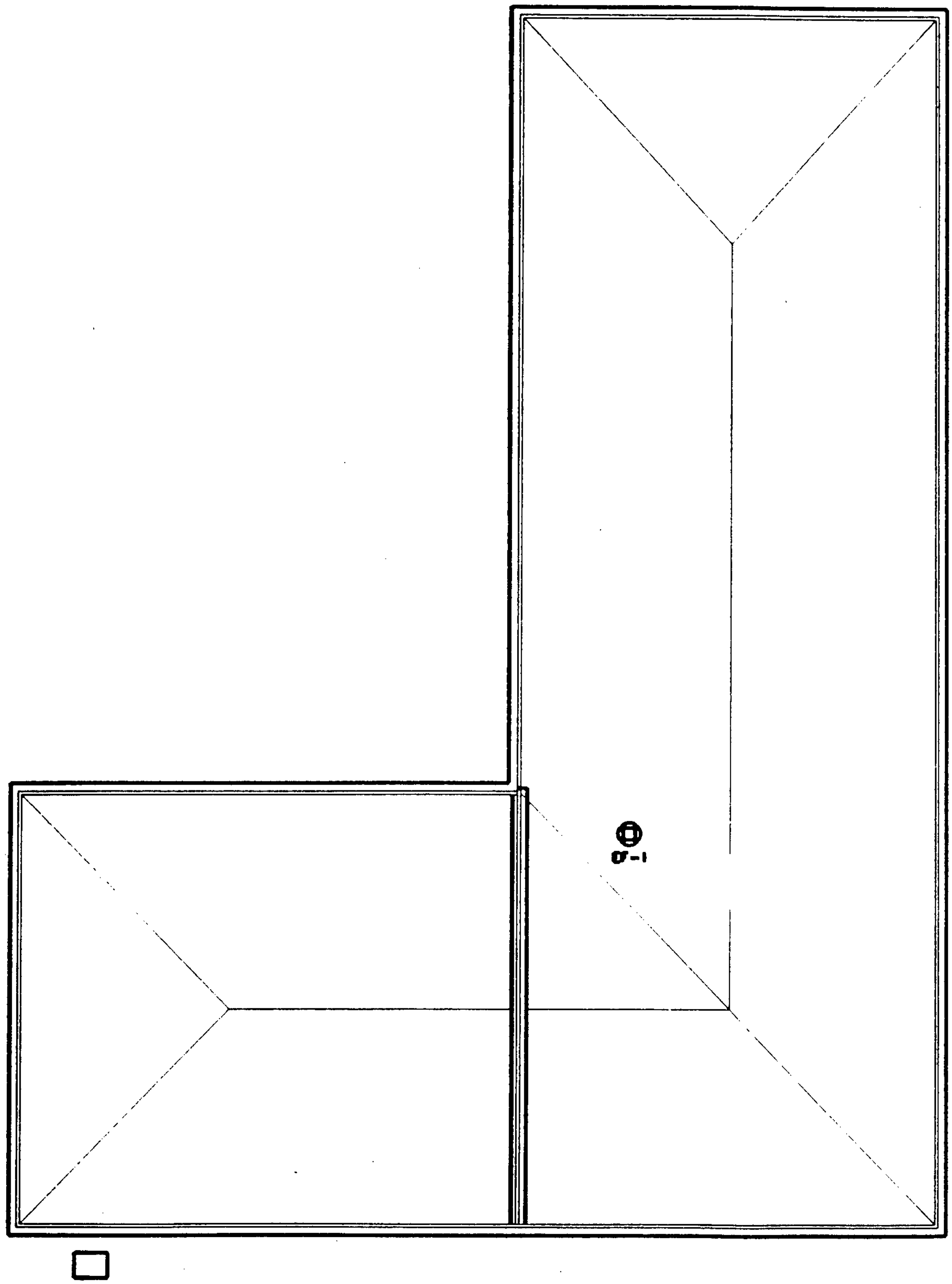
Project No.: 60692.00
Designed by:
Drawn by: FE/DLS

Title: BUILDING 1425 – SECOND FLOOR & ROO
MECHANICAL EQUIPMENT LOCATION PLAN

Modifies Drawing No.:
Scale: 1/16" = 1'-

B-16

2



BUILDING 1425 - SECOND FLOOR & ROOF
MECHANICAL EQUIPMENT LOCATION PLAN

Date: 14 JULY 94
Sheet No.: 2 of: 2

ies Drawing No.:
Scale: 1/16" = 1'-0"
Drawing No.:

3

BUILDING 3136

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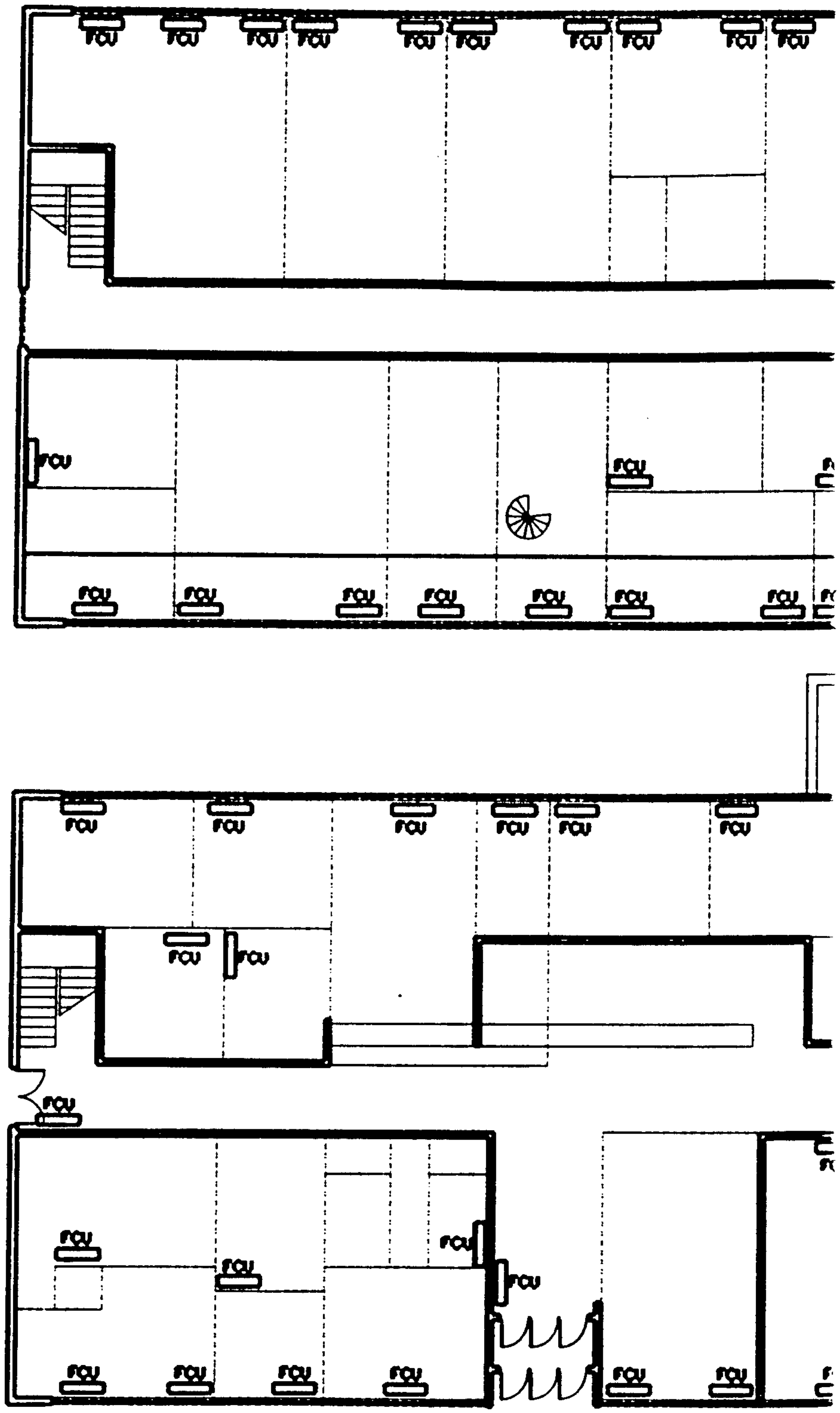
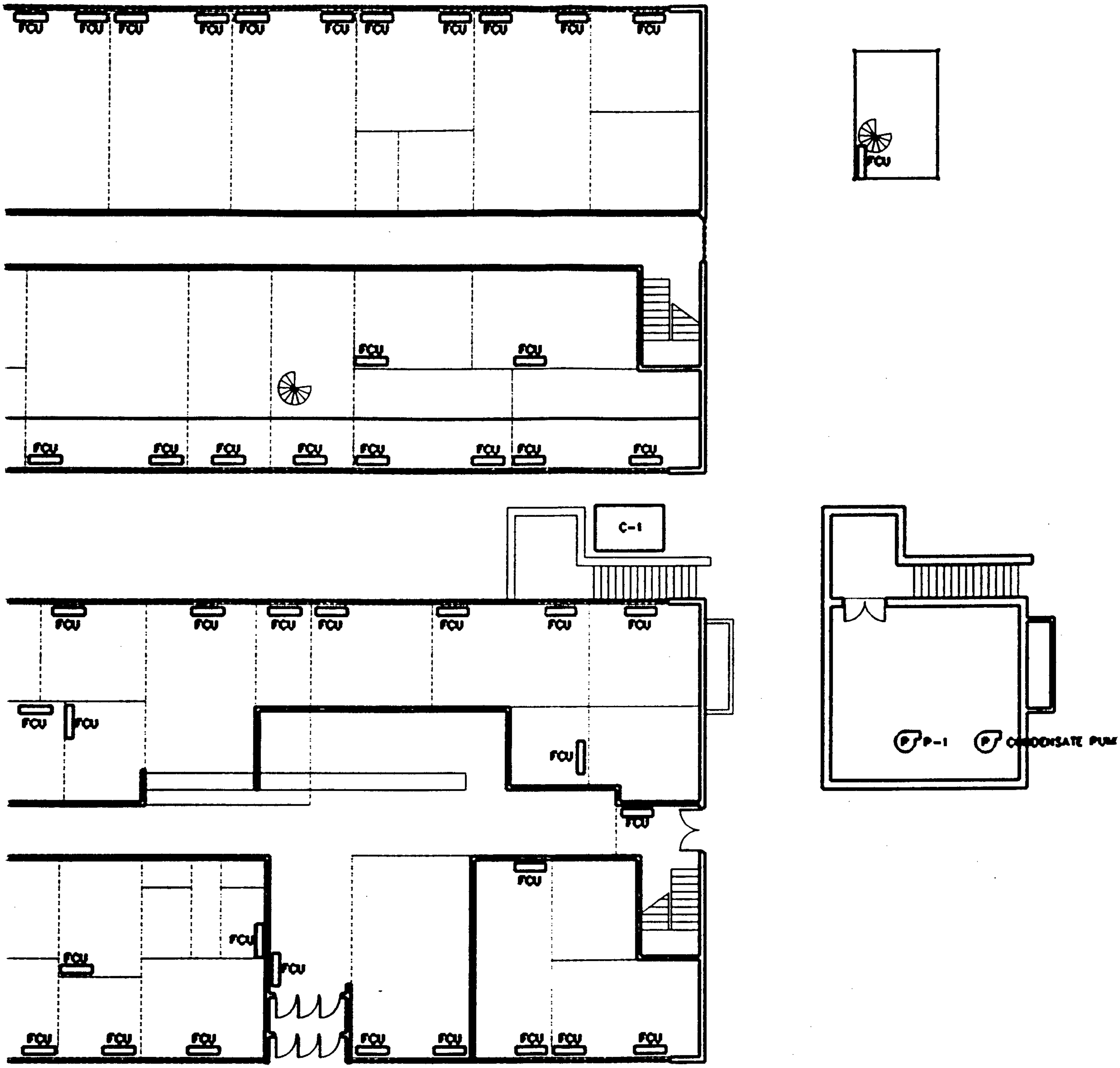


Project: FT. BELVOIR EMS STUDY

Project No.: 60692.00

Designed by:

Drawn by FE/DLS



Project No.: 60692.00

Designed by:

Drawn by FE/DLS

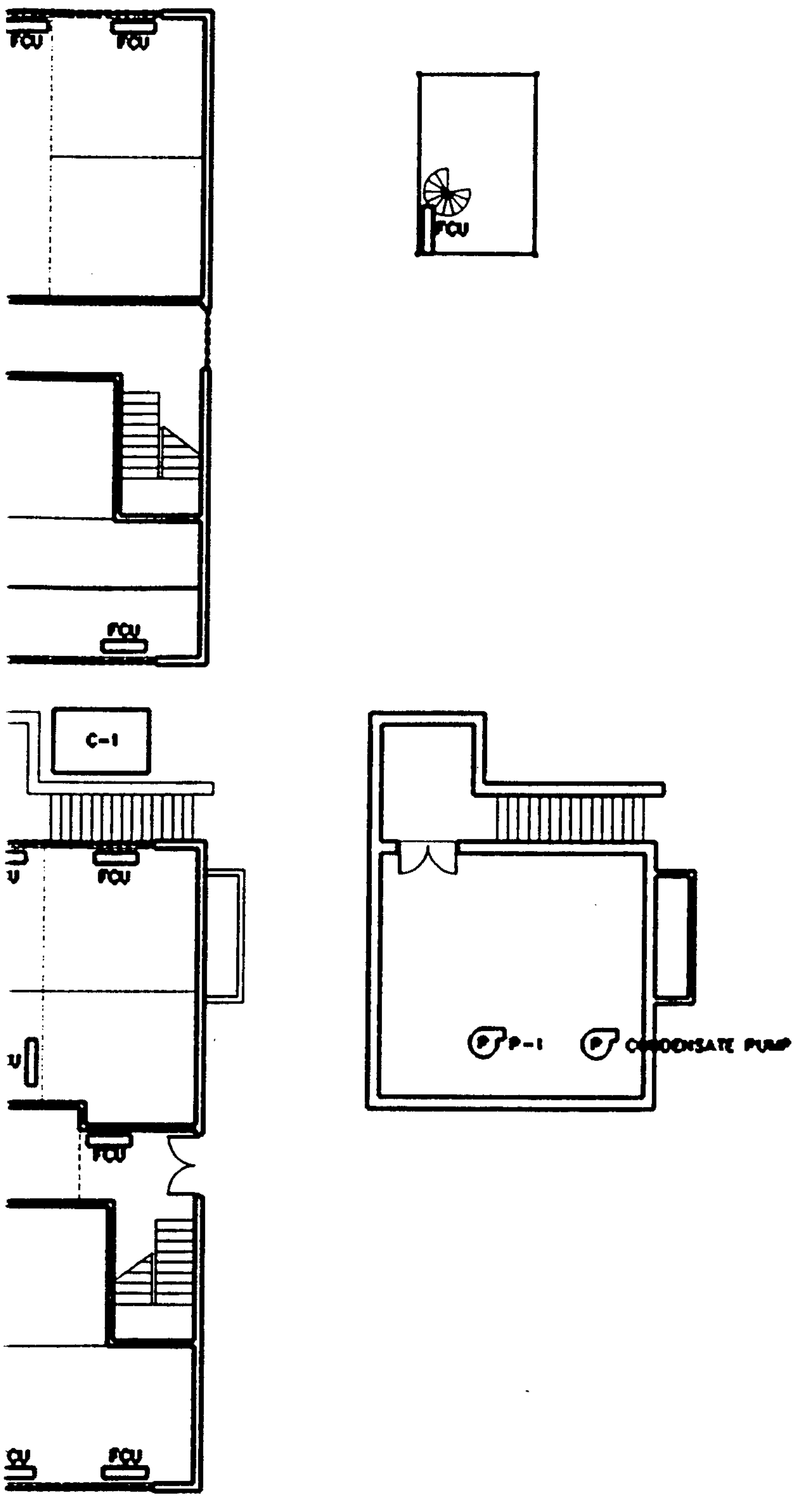
Title: BUILDING 3136 – FIRST AND SECON
FLOOR EQUIPMENT LOCATION PLANS

Modifies Drawing No.

Scale: 1/16" = 1'0"

-18

2



: BUILDING 3136 – FIRST AND SECON
FLOOR EQUIPMENT LOCATION PLANS

Date: 14 JULY 94
Sheet No.: 1 of 1

ifies Drawing No. ______ Scale: 1/16" = 1'0" Drawing No.: ______

3

APPENDIX C
CARRIER E20-II
BUILDING SIMULATION
INPUT DATA

BUILDING 200

****

TABLE 1. SIMULATION WEATHER DATA DESIGN PARAMETERS

City	Washington
Location	Dist. of Columbia
Type of Data	Typical Meteorological Year
Latitude	38.9 deg
Longitude	77.0 deg
Elevation	14.0 ft
* Average Ground Reflectivity	0.20
Local Time Zone (GMT +/- N hours)	5.0 hours
* Daylight Savings Time Considered?	N

* = User-defined design parameters. All other values are fixed.

TABLE 2. DRY-BULB TEMPERATURE STATISTICS (F)

Month	Absolute Maximum	Average Maximum	Average	Average Minimum	Absolute Minimum
January	60.4	39.3	30.7	21.0	-1.9
February	62.1	42.8	33.1	22.9	7.5
March	75.5	53.9	43.3	32.4	17.1
April	85.5	65.7	55.0	44.3	31.2
May	91.9	73.3	63.5	53.8	40.5
June	93.5	80.8	70.0	58.8	48.8
July	91.0	84.9	75.9	66.5	55.8
August	96.8	85.1	74.3	64.5	49.6
September	91.6	79.3	69.3	60.0	46.5
October	84.7	67.5	56.8	46.7	23.4
November	75.7	56.4	46.6	35.7	17.3
December	59.0	42.7	36.9	30.9	20.5

TABLE 3. DAILY TOTAL SOLAR RADIATION STATISTICS

	[---- Daily Total Solar ---] (BTU/sqft)			[-- Daily Clearness Number --] (Dimensionless)		
Month	Maximum	Average	Minimum	Maximum	Average	Minimum
January	1043.4	609.1	137.7	0.648	0.430	0.107
February	1448.6	815.5	79.9	0.685	0.433	0.048
March	1861.2	1183.4	211.6	0.680	0.473	0.094
April	2371.0	1484.8	247.6	0.717	0.479	0.079
May	2579.4	1712.0	355.4	0.711	0.487	0.104
June	2551.8	1890.8	515.8	0.697	0.514	0.140
July	2398.3	1714.6	629.5	0.657	0.478	0.171
August	2378.9	1696.2	708.2	0.694	0.522	0.227
September	1943.6	1307.6	258.0	0.674	0.482	0.094
October	1546.1	977.2	92.6	0.656	0.469	0.045
November	1143.4	672.4	129.4	0.647	0.437	0.094
December	803.2	488.0	73.1	0.618	0.382	0.057

Notes: * All solar data is daily total flux on a horizontal surface.
* Clearness number is (Daily Total Solar)/(Extraterrestrial Solar) Values between 0.70 and 0.80 represent clear conditions.

CALENDAR DATA

Prepared By: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04

****

Calendar Name: Sample Calendar	Day Type Assignments
January first is on: Friday	Monday = Weekday Tuesday = Weekday Wednesday = Weekday
Day Type Names Day Type 1 = Weekday Day Type 2 = Saturday Day Type 3 = Sunday	Thursday = Weekday Friday = Weekday Saturday = Saturday Sunday = Sunday Holiday = Sunday

Holidays

(No holidays specified)

SCHEDULE DATA

Prepared By: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04

Schedule Name: Assembly Spaces Hourly Percentages

Hour ----->	00	01	02	03	04	05	06	07	08	09	10	11
DESIGN DAY	0	0	0	0	0	0	0	10	25	50	75	100
Weekday	0	0	0	0	0	0	0	10	25	25	25	30
Saturday	0	0	0	0	0	0	0	0	0	0	10	25
Sunday	0	0	0	0	0	0	0	0	0	0	10	25

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
DESIGN DAY	100	100	100	100	100	100	100	100	100	100	75	100
Weekday	40	40	40	30	25	25	25	25	25	25	20	10
Saturday	25	40	40	30	25	25	25	25	25	25	10	0
Sunday	25	40	40	30	25	25	25	10	0	0	0	0

Schedule Name: People Hourly Percentages

Hour ----->	00	01	02	03	04	05	06	07	08	09	10	11
DESIGN DAY	0	0	0	0	0	0	0	10	25	50	75	100
Weekday	0	0	0	0	0	0	0	10	25	50	75	100
Saturday	0	0	0	0	0	0	0	0	0	0	10	25
Sunday	0	0	0	0	0	0	0	0	0	0	10	25

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
DESIGN DAY	100	100	100	100	100	100	100	100	100	100	75	10
Weekday	100	100	100	100	100	100	100	100	100	100	75	10
Saturday	10	25	50	75	100	100	100	100	100	100	100	75
Sunday	50	75	100	100	100	100	100	10	0	0	0	0

Schedule Name: Lights Hourly Percentages

Hour ----->	00	01	02	03	04	05	06	07	08	09	10	11
DESIGN DAY	25	25	25	25	25	25	25	100	100	100	100	100
Weekday	25	25	25	25	25	25	25	100	100	100	100	100
Saturday	25	25	25	25	25	25	25	25	25	25	25	25
Sunday	25	25	25	25	25	25	25	25	25	25	100	100

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
DESIGN DAY	100	100	100	100	100	100	100	100	100	100	100	100
Weekday	100	100	100	100	100	100	100	100	100	100	100	100
Saturday	100	100	100	100	100	100	100	100	100	100	100	100
Sunday	100	100	100	100	100	100	100	100	25	25	25	25

WALL CONSTRUCTION TYPES

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04 Page 1

****

WALL TYPE 1: (CUSTOM WALL)

Description...........: Brick/Block

Absorptivity..........: 0.900

Layer Description	Thickness	Density	Spec.Ht	R-Val	Weight
Inside surface resistance	-	-	-	0.69	-
6in LW concrete block	6.00	19.0	0.21	1.65	9.5
Vermiculite Insulation	3.00	6.0	0.32	6.45	1.5
Airspace	1.00	0.0	0.00	0.91	0.0
4-in (102 mm) face brick	4.00	125.0	0.22	0.43	41.7
Outside surface resistance	-	-	-	0.33	-
Totals	14.00			10.46	52.7

Thickness: in Density: lb/cuft Weight: lb/sqft

R-value : (hr-sqft-F)/BTU Specific Heat: BTU/lb/F

****

ROOF TYPE 1: (PRE-DEFINED ROOF)

Group.........: BUILT-UP ROOF ON STEEL OR WOOD
Type..........: Built-up roof + R-7 board + steel deck
Description...: Pre-Defined Roof
U-value.......: 0.121 BTU/hr/sqft/F
Color.........: Dark

Roof Construction (Inside to Outside):
22 gage steel deck
R-7 (RSI-1.2) board insulation
Built-up roofing

****

WINDOW TYPE 1: (PRE-DEFINED WINDOW)

Glass Group............: SINGLE PANE, CLEAR
Glass Type.............: 1/4" clear
Window Description.....: Pre-Defined Window
Height.................: 1.00 ft
Width..................: 1.00 ft
Frame Type.............: Aluminum with thermal breaks
Interior Shade Type....: No Shades Used
Overall U-value........: 1.077 BTU/hr/sqft/F
Overall Shade Coeff....: 0.871

Predefined Glass Data

Glass Transmissivity	Glass Reflectivity	Glass Absorptivity	Glass U-Value	Shade Coefficient
0.792	0.079	0.129	1.090	0.960

WINDOW TYPE 2: (PRE-DEFINED WINDOW)

Glass Group............: SINGLE PANE, CLEAR
Glass Type.............: 1/8" clear
Window Description.....: Pre-Defined Window
Height.................: 1.00 ft
Width..................: 1.00 ft
Frame Type.............: Aluminum with thermal breaks
Interior Shade Type....: No Shades Used
Overall U-value........: 1.094 BTU/hr/sqft/F
Overall Shade Coeff....: 0.903

Predefined Glass Data

Glass Transmissivity	Glass Reflectivity	Glass Absorptivity	Glass U-Value	Shade Coefficient
0.841	0.078	0.081	1.110	1.000

****

BASIC ELECTRIC RATE INFORMATION

ELECTRIC	Rate schedule name......:	Ft. Belvoir Equivalent $/kWh
RATE	Currency symbol.....................:	$
INFORMATION:	Type of rate schedule...............:	Simple
	Flat rate...........................:	0.01968 $/kWh

****

BASIC FUEL RATE INFORMATION

FUEL RATE INFORMATION:	Rate schedule name.......:	Ft. Belvoir District Steam
	Currency symbol..............:	$
	Units of measurement.........:	1000 lb
	Fuel conversion factor.......:	1000.00000 kBTU/1000 lb
	Type of rate schedule........:	Simple
	Flat rate....................:	7.98000 $/1000 lb

FUEL RATE DATA

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04 Page 1

****

BASIC FUEL RATE INFORMATION

FUEL RATE INFORMATION:	Rate schedule name.......:	Washington Gas Rate Schedule 2
	Currency symbol.............:	$
	Units of measurement.........:	Therm
	Fuel conversion factor.......:	100.00000 kBTU/Therm
	Type of rate schedule........:	Simple
	Flat rate....................:	0.60790 $/Therm

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04

GENERAL

Name......: AHU-1 Assembly / Travel
Floor Area......: 1728.0 sqft
Building Weight.: 70.0 lb/sqft
Windows Shaded..? N
Partitions Used.? Y

LIGHTING

Overhead Fixture: Recessed
Lamp Wattage....: 3.00 W/sqft
Ballast Mult....: 1.00
Task Lighting...: 0.00 W/sqft

PEOPLE

Occupancy.......: 25.0 sqft/per
Activity Level..: Office Work
Sensible........: 245.0 BTU/hr
Latent..........: 205.0 BTU/hr

OTHER LOADS

Equipment.......: 0.00 W/sqft
Misc. Sensible..: 0.0 BTU/hr
Misc. Latent....: 0.0 BTU/hr

SCHEDULES

Lighting....: Lights
Task Lights.: Lights
People......: Assembly Spaces
Equipment...: People
Misc. Sens..: People
Misc. Latent: People

INFILTRATION

Cooling.....: 0.00 CFM/sqft
Heating.....: 0.00 CFM/sqft
Typical.....: 0.00 CFM/sqft
When Fan On.? N

FLOOR

Type........:Slab On Grade
Perimeter.............: 100.0 ft
Slab Floor Area.......: 80.0 sqft
Floor R-Value.........: 2.40
Insulation R-value....: 0.00

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
N	384.0	1	1	0	-	1	0	-	N
E	783.0	1	1	240	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	1728.0	1	1	0

PARTITION LOADS	Type 1	Type 2
Type..................:	Partition	Ceiling
Area..................:	286.0 sqft	0.0 sqft
U-value...............:	0.080 BTU/hr/sqft/F	0.500 BTU/hr/sqft/F
Maximum Space Temp....:	95.0 F	75.0 F
Outside Air Temp @ Max:	95.0 F	55.0 F
Minimum Space Temp....:	0.0 F	75.0 F
Outside Air Temp @ Min:	0.0 F	54.0 F

C-11

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04

****

GENERAL
- Name......: AHU 2-1 Multi-Purpose
- Floor Area......: 2376.0 sqft
- Building Weight.: 70.0 lb/sqft
- Windows Shaded..? N
- Partitions Used.? N

LIGHTING
- Overhead Fixture: Recessed
- Lamp Wattage....: 3.60 W/sqft
- Ballast Mult....: 1.00
- Task Lighting...: 0.00 W/sqft

PEOPLE
- Occupancy.......: 40.0 sqft/per
- Activity Level..: Sedentary Work
- Sensible........: 280.0 BTU/hr
- Latent..........: 270.0 BTU/hr

OTHER LOADS
- Equipment.......: 0.00 W/sqft
- Misc. Sensible..: 0.0 BTU/hr
- Misc. Latent....: 0.0 BTU/hr

SCHEDULES
- Lighting....: Lights
- Task Lights.: Lights
- People......: Assembly Spaces
- Equipment...: People
- Misc. Sens..: People
- Misc. Latent: People

INFILTRATION
- Cooling.....: 0.00 CFM/sqft
- Heating.....: 0.00 CFM/sqft
- Typical.....: 0.00 CFM/sqft
- When Fan On.? N

FLOOR
- Type........:Slab On Grade
- Perimeter............: 130.0 ft
- Slab Floor Area.......: 2376.0 sqft
- Floor R-Value.........: 2.40
- Insulation R-value....: 0.00

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
W	440.0	1	1	75	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	2376.0	1	1	0

No partition data for this space.

GENERAL
Name......: AHU 2-2 Stage
Floor Area......: 1620.0 sqft
Building Weight.: 70.0 lb/sqft
Windows Shaded..? N
Partitions Used.? N

LIGHTING
Overhead Fixture: Recessed
Lamp Wattage....: 5.00 W/sqft
Ballast Mult....: 1.00
Task Lighting...: 0.00 W/sqft

PEOPLE
Occupancy.......: 40.0 sqft/per
Activity Level..: Medium Work
Sensible........: 295.0 BTU/hr
Latent..........: 455.0 BTU/hr

OTHER LOADS
Equipment.......: 0.00 W/sqft
Misc. Sensible..: 0.0 BTU/hr
Misc. Latent....: 0.0 BTU/hr

SCHEDULES
Lighting....: Lights
Task Lights.: Lights
People......: Assembly Spaces
Equipment...: People
Misc. Sens..: People
Misc. Latent: People

INFILTRATION
Cooling.....: 0.00 CFM/sqft
Heating.....: 0.00 CFM/sqft
Typical.....: 0.00 CFM/sqft
When Fan On.? N

FLOOR
Type........:Slab On Grade
Perimeter............: 130.0 ft
Slab Floor Area.......: 1620.0 sqft
Floor R-Value.........: 2.40
Insulation R-value....: 0.00

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
W	360.0	1	1	0	-	1	0	-	N
N	864.0	1	1	0	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	1620.0	1	1	0

No partition data for this space.

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04

****

GENERAL
- Name......: AHU 2-3 Multi-Purpose
- Floor Area......: 2135.0 sqft
- Building Weight.: 70.0 lb/sqft
- Windows Shaded..? N
- Partitions Used.? N

LIGHTING
- Overhead Fixture: Recessed
- Lamp Wattage....: 3.60 W/sqft
- Ballast Mult....: 1.00
- Task Lighting...: 0.00 W/sqft

PEOPLE
- Occupancy.......: 40.0 sqft/per
- Activity Level..: Sedentary Work
- Sensible........: 280.0 BTU/hr
- Latent..........: 270.0 BTU/hr

OTHER LOADS
- Equipment.......: 0.00 W/sqft
- Misc. Sensible..: 0.0 BTU/hr
- Misc. Latent....: 0.0 BTU/hr

SCHEDULES
- Lighting....: Lights
- Task Lights.: Lights
- People......: Assembly Spaces
- Equipment...: People
- Misc. Sens..: People
- Misc. Latent: People

INFILTRATION
- Cooling.....: 0.00 CFM/sqft
- Heating.....: 0.00 CFM/sqft
- Typical.....: 0.00 CFM/sqft
- When Fan On.? N

FLOOR
- Type........:Slab On Grade
- Perimeter.............: 140.0 ft
- Slab Floor Area.......: 2135.0 sqft
- Floor R-Value.........: 2.40
- Insulation R-value....: 0.00

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
E	480.0	1	1	20	-	1	0	-	N
S	286.0	1	1	96	-	1	0	-	N
SE	420.0	1	1	0	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	2135.0	1	1	0

No partition data for this space.

SPACE DESCRIPTION

GENERAL

- Name......: AHU 3 Concourse
- Floor Area......: 4500.0 sqft
- Building Weight.: 70.0 lb/sqft
- Windows Shaded..? N
- Partitions Used.? N

LIGHTING

- Overhead Fixture: Recessed
- Lamp Wattage....: 2.00 W/sqft
- Ballast Mult....: 1.00
- Task Lighting...: 0.00 W/sqft

PEOPLE

- Occupancy.......: 225.0 sqft/per
- Activity Level..: Office Work
- Sensible........: 245.0 BTU/hr
- Latent..........: 205.0 BTU/hr

OTHER LOADS

- Equipment.......: 0.00 W/sqft
- Misc. Sensible..: 0.0 BTU/hr
- Misc. Latent....: 0.0 BTU/hr

SCHEDULES

- Lighting....: Lights
- Task Lights.: Lights
- People......: People
- Equipment...: People
- Misc. Sens..: People
- Misc. Latent: People

INFILTRATION

- Cooling.....: 0.00 CFM/sqft
- Heating.....: 0.00 CFM/sqft
- Typical.....: 0.00 CFM/sqft
- When Fan On.? N

FLOOR

- Type........:Slab On Grade
- Perimeter.............: 80.0 ft
- Slab Floor Area.......: 4500.0 sqft
- Floor R-Value.........: 2.40
- Insulation R-value....: 0.00

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
S	960.0	1	1	765	-	1	0	-	N
N	620.0	1	1	510	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	2313.0	1	2	540

No partition data for this space.

```
                         SPACE DESCRIPTION
Prepared by: EINHORN YAFFEE PRESCOTT                             12-30-94
HAP v3.04                                                        Page  1
******************************************************************************
GENERAL                                SCHEDULES
 Name......: AHU 4-1 Music Room         Lighting....: Lights
 Floor Area......:      340.0 sqft      Task Lights.: Lights
 Building Weight.:       70.0 lb/sqft   People......: People
 Windows Shaded..?          N           Equipment...: People
 Partitions Used.?          N           Misc. Sens..: People
LIGHTING                                Misc. Latent: People
 Overhead Fixture: Recessed            INFILTRATION
 Lamp Wattage....:       3.00 W/sqft    Cooling.....:       0.00 CFM/sqft
 Ballast Mult....:       1.00           Heating.....:       0.00 CFM/sqft
 Task Lighting...:       0.00 W/sqft    Typical.....:       0.00 CFM/sqft
PEOPLE                                  When Fan On.?         N
 Occupancy.......:      170.0 sqft/per FLOOR
 Activity Level..: Office Work          Type........:Slab On Grade
 Sensible........:      245.0 BTU/hr    Perimeter............:         0.0 ft
 Latent..........:      205.0 BTU/hr    Slab Floor Area.......:      340.0 sqft
OTHER LOADS                             Floor R-Value.........:       2.40
 Equipment.......:       0.00 W/sqft    Insulation R-value....:       0.00
 Misc. Sensible..:        0.0 BTU/hr
 Misc. Latent....:        0.0 BTU/hr
==============================================================================
No external wall or window data for this space.
==============================================================================
ROOF  Slope    Gross Area  | ROOF | SKYLIGHT  |
Exp   (deg)        (sqft)  | Type |Type   Qty |
-------------------------------------------------|
HOR      -          340.0  |    1 |  2      0  |
==============================================================================
No partition data for this space.
==============================================================================
```

C-16

SPACE DESCRIPTION

****

GENERAL		SCHEDULES	
Name......:	AHU 4-2 TV Room	Lighting....:	Lights
Floor Area......:	578.0 sqft	Task Lights.:	Lights
Building Weight.:	70.0 lb/sqft	People......:	People
Windows Shaded..?	N	Equipment...:	People
Partitions Used.?	N	Misc. Sens..:	People
LIGHTING		Misc. Latent:	People
Overhead Fixture:	Recessed	INFILTRATION	
Lamp Wattage....:	2.10 W/sqft	Cooling.....:	0.00 CFM/sqft
Ballast Mult....:	1.00	Heating.....:	0.00 CFM/sqft
Task Lighting...:	0.00 W/sqft	Typical.....:	0.00 CFM/sqft
PEOPLE		When Fan On.?	N
Occupancy.......:	144.0 sqft/per	FLOOR	
Activity Level..:	Seated at Rest	Type........:	Slab On Grade
Sensible........:	230.0 BTU/hr	Perimeter.............:	0.0 ft
Latent..........:	120.0 BTU/hr	Slab Floor Area.......:	578.0 sqft
OTHER LOADS		Floor R-Value.........:	2.40
Equipment.......:	0.00 W/sqft	Insulation R-value....:	0.00
Misc. Sensible..:	0.0 BTU/hr		
Misc. Latent....:	0.0 BTU/hr		

==

No external wall or window data for this space.

==

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	578.0	1	2	0

==

No partition data for this space.

==

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

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```
****************************************************************************
GENERAL                                     SCHEDULES
 Name......: AHU 4-3 Mini Auditorium         Lighting....: Lights
 Floor Area......:      250.0 sqft           Task Lights.: Lights
 Building Weight.:       70.0 lb/sqft        People......: Assembly Spaces
 Windows Shaded..?          N                Equipment...: People
 Partitions Used.?          N                Misc. Sens..: People
LIGHTING                                     Misc. Latent: People
 Overhead Fixture: Recessed                 INFILTRATION
 Lamp Wattage....:       4.20 W/sqft         Cooling.....:      0.00 CFM/sqft
 Ballast Mult....:       1.00                Heating.....:      0.00 CFM/sqft
 Task Lighting...:       0.00 W/sqft         Typical.....:      0.00 CFM/sqft
PEOPLE                                       When Fan On.?         N
 Occupancy.......:       50.0 sqft/per      FLOOR
 Activity Level..: Seated at Rest            Type........:Slab On Grade
 Sensible........:      230.0 BTU/hr         Perimeter.............:      0.0 ft
 Latent..........:      120.0 BTU/hr         Slab Floor Area.......:    250.0 sqft
OTHER LOADS                                  Floor R-Value.........:     2.40
 Equipment.......:       0.00 W/sqft         Insulation R-value....:     0.00
 Misc. Sensible..:        0.0 BTU/hr
 Misc. Latent....:        0.0 BTU/hr
============================================================================
No external wall or window data for this space.
============================================================================
ROOF  Slope    Gross Area  | ROOF | SKYLIGHT  |
Exp   (deg)        (sqft)  | Type |Type   Qty |
-----------------------------------------------|
HOR      -         250.0   |    1 |  2      0 |
============================================================================
No partition data for this space.
============================================================================
```

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SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

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****

GENERAL
Name......: AHU 4-4 Crafts Room
Floor Area......: 480.0 sqft
Building Weight.: 70.0 lb/sqft
Windows Shaded..? N
Partitions Used.? N

LIGHTING
Overhead Fixture: Recessed
Lamp Wattage....: 3.00 W/sqft
Ballast Mult....: 1.00
Task Lighting...: 0.00 W/sqft

PEOPLE
Occupancy.......: 50.0 sqft/per
Activity Level..: Seated at Rest
Sensible........: 230.0 BTU/hr
Latent..........: 120.0 BTU/hr

OTHER LOADS
Equipment.......: 0.00 W/sqft
Misc. Sensible..: 0.0 BTU/hr
Misc. Latent....: 0.0 BTU/hr

SCHEDULES
Lighting....: Lights
Task Lights.: Lights
People......: People
Equipment...: People
Misc. Sens..: People
Misc. Latent: People

INFILTRATION
Cooling.....: 0.00 CFM/sqft
Heating.....: 0.00 CFM/sqft
Typical.....: 0.00 CFM/sqft
When Fan On.? N

FLOOR
Type........:Slab On Grade
Perimeter.............: 0.0 ft
Slab Floor Area.......: 480.0 sqft
Floor R-Value.........: 2.40
Insulation R-value....: 0.00

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
W	528.0	1	1	0	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	480.0	1	2	0

No partition data for this space.

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SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04 Page 1

****

```
GENERAL                                      SCHEDULES
 Name......: AHU 4-5 Reading Room             Lighting....: Lights
 Floor Area......:      504.0 sqft            Task Lights.: Lights
 Building Weight.:       70.0 lb/sqft         People......: People
 Windows Shaded..?         N                  Equipment...: People
 Partitions Used.?         N                  Misc. Sens..: People
LIGHTING                                      Misc. Latent: People
 Overhead Fixture: Recessed                  INFILTRATION
 Lamp Wattage....:       2.40 W/sqft          Cooling.....:        0.00 CFM/sqft
 Ballast Mult....:       1.00                 Heating.....:        0.00 CFM/sqft
 Task Lighting...:       0.00 W/sqft          Typical.....:        0.00 CFM/sqft
PEOPLE                                        When Fan On.?           N
 Occupancy.......:      100.0 sqft/per   FLOOR
 Activity Level..: Seated at Rest             Type........:Slab On Grade
 Sensible........:      230.0 BTU/hr          Perimeter............:        0.0 ft
 Latent..........:      120.0 BTU/hr          Slab Floor Area.......:      504.0 sqft
OTHER LOADS                                   Floor R-Value.........:       2.40
 Equipment.......:       0.00 W/sqft          Insulation R-value....:       0.00
 Misc. Sensible..:        0.0 BTU/hr
 Misc. Latent....:        0.0 BTU/hr
```

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
S	288.0	1	1	144	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	504.0	1	2	0

No partition data for this space.

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SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

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****

GENERAL
- Name......: AHU 4-6 Office
- Floor Area......: 588.0 sqft
- Building Weight.: 70.0 lb/sqft
- Windows Shaded..? N
- Partitions Used.? N

LIGHTING
- Overhead Fixture: Recessed
- Lamp Wattage....: 2.00 W/sqft
- Ballast Mult....: 1.00
- Task Lighting...: 0.00 W/sqft

PEOPLE
- Occupancy.......: 294.0 sqft/per
- Activity Level..: Office Work
- Sensible........: 245.0 BTU/hr
- Latent..........: 205.0 BTU/hr

OTHER LOADS
- Equipment.......: 0.00 W/sqft
- Misc. Sensible..: 1500.0 BTU/hr
- Misc. Latent....: 0.0 BTU/hr

SCHEDULES
- Lighting....: Lights
- Task Lights.: Lights
- People......: People
- Equipment...: People
- Misc. Sens..: People
- Misc. Latent: People

INFILTRATION
- Cooling.....: 0.00 CFM/sqft
- Heating.....: 0.00 CFM/sqft
- Typical.....: 0.00 CFM/sqft
- When Fan On.? N

FLOOR
- Type........:Slab On Grade
- Perimeter.............: 28.0 ft
- Slab Floor Area.......: 588.0 sqft
- Floor R-Value.........: 2.40
- Insulation R-value....: 0.00

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
S	336.0	1	1	24	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	588.0	1	2	0

No partition data for this space.

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SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04 Page 1

```
************************************************************************************
GENERAL                                     SCHEDULES
 Name......: AHU 4-7 Offices                 Lighting....: Lights
 Floor Area......:    710.0 sqft             Task Lights.: Lights
 Building Weight.:     70.0 lb/sqft          People......: People
 Windows Shaded..?        N                  Equipment...: People
 Partitions Used.?        N                  Misc. Sens..: People
LIGHTING                                     Misc. Latent: People
 Overhead Fixture: Recessed                 INFILTRATION
 Lamp Wattage....:     2.50 W/sqft           Cooling.....:      0.00 CFM/sqft
 Ballast Mult....:     1.00                  Heating.....:      0.00 CFM/sqft
 Task Lighting...:     0.00 W/sqft           Typical.....:      0.00 CFM/sqft
PEOPLE                                       When Fan On.?         N
 Occupancy.......:    236.0 sqft/per        FLOOR
 Activity Level..: Office Work               Type........:Slab On Grade
 Sensible........:    245.0 BTU/hr           Perimeter............:        0.0 ft
 Latent..........:    205.0 BTU/hr           Slab Floor Area.......:     710.0 sqft
OTHER LOADS                                  Floor R-Value.........:      2.40
 Equipment.......:     0.00 W/sqft           Insulation R-value....:      0.00
 Misc. Sensible..:   3000.0 BTU/hr
 Misc. Latent....:      0.0 BTU/hr
============================================================================
No external wall or window data for this space.
============================================================================
ROOF  Slope    Gross Area  | ROOF | SKYLIGHT  |
Exp   (deg)        (sqft)  | Type |Type   Qty |
-------------------------------------------------|
HOR     -          710.0   |    1 |  2      0 |
============================================================================
No partition data for this space.
============================================================================
```

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SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04 Page 1

****

GENERAL		SCHEDULES	
Name......:	AHU 5 Acivity Room	Lighting....:	Lights
Floor Area......:	3545.0 sqft	Task Lights.:	Lights
Building Weight.:	70.0 lb/sqft	People......:	Assembly Spaces
Windows Shaded..?	N	Equipment...:	People
Partitions Used.?	N	Misc. Sens..:	People
LIGHTING		Misc. Latent:	People
Overhead Fixture:	Recessed	INFILTRATION	
Lamp Wattage....:	2.80 W/sqft	Cooling.....:	0.00 CFM/sqft
Ballast Mult....:	1.00	Heating.....:	0.00 CFM/sqft
Task Lighting...:	0.00 W/sqft	Typical.....:	0.00 CFM/sqft
PEOPLE		When Fan On.?	N
Occupancy.......:	177.0 sqft/per	FLOOR	
Activity Level..:	Office Work	Type........:	Slab On Grade
Sensible........:	245.0 BTU/hr	Perimeter.............:	200.0 ft
Latent..........:	205.0 BTU/hr	Slab Floor Area.......:	3545.0 sqft
OTHER LOADS		Floor R-Value.........:	2.40
Equipment.......:	4500.0 W	Insulation R-value....:	0.00
Misc. Sensible..:	0.0 BTU/hr		
Misc. Latent....:	0.0 BTU/hr		

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
W	152.0	1	1	0	-	1	0	-	N
E	1510.0	1	1	510	-	1	0	-	N
NW	385.0	1	1	0	-	1	0	-	N
N	290.0	1	1	0	-	1	0	-	N
S	476.0	1	1	0	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	3545.0	1	2	0

No partition data for this space.

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04 Page 1

GENERAL
- Name......: AHU 6 Travel / Kitchen
- Floor Area......: 2048.0 sqft
- Building Weight.: 70.0 lb/sqft
- Windows Shaded..? N
- Partitions Used.? Y

LIGHTING
- Overhead Fixture: Recessed
- Lamp Wattage....: 2.80 W/sqft
- Ballast Mult....: 1.00
- Task Lighting...: 0.00 W/sqft

PEOPLE
- Occupancy.......: 165.0 sqft/per
- Activity Level..: Office Work
- Sensible........: 245.0 BTU/hr
- Latent..........: 205.0 BTU/hr

OTHER LOADS
- Equipment.......: 0.0 W
- Misc. Sensible..: 5000.0 BTU/hr
- Misc. Latent....: 0.0 BTU/hr

SCHEDULES
- Lighting....: Lights
- Task Lights.: Lights
- People......: People
- Equipment...: People
- Misc. Sens..: People
- Misc. Latent: People

INFILTRATION
- Cooling.....: 0.00 CFM/sqft
- Heating.....: 0.00 CFM/sqft
- Typical.....: 0.00 CFM/sqft
- When Fan On.? N

FLOOR
- Type........:Slab On Grade
- Perimeter.............: 0.0 ft
- Slab Floor Area.......: 992.0 sqft
- Floor R-Value.........: 2.40
- Insulation R-value....: 0.00

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
N	325.0	1	1	0	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	2048.0	1	2	0

PARTITION LOADS	Type 1	Type 2
Type.................:	Partition	Ceiling
Area.................:	345.0 sqft	0.0 sqft
U-value..............:	0.080 BTU/hr/sqft/F	0.500 BTU/hr/sqft/F
Maximum Space Temp....:	95.0 F	75.0 F
Outside Air Temp @ Max:	95.0 F	55.0 F
Minimum Space Temp....:	0.0 F	75.0 F
Outside Air Temp @ Min:	0.0 F	54.0 F

AIR SYSTEM INPUT DATA


```
*************************************************************************

1. SYSTEM NAME AND TYPE
-------------------------------------------------------------------------
  Name............: AHU-1  Baseline
  Type............: CONSTANT VOLUME - Single Zone CAV
  Number of Zones.:  1
=========================================================================

2. SYSTEM DESCRIPTION
-------------------------------------------------------------------------
COOLING SYSTEM DATA
 Is Central Cooling Used.......?            Y
 Supply Air....................:         55.0 F
 Coil Bypass Factor............:        0.100
 Fan Cycled for Cooling........?            N
 Supply Air Reset..............:    Not Used
HEATING SYSTEM DATA
 Is Central Heating Used.......?            Y
 Fan Cycled for Heating........?            N
 Supply Air Reset..............:    Not Used
OUTDOOR VENTILATION DATA
 Type of Control...............:    Constant Airflow Rate
 Design Ventilation Airflow....:       2135.0 CFM
 Dampers Open During Unocc Per.:            N
 Damper Leak Rate..............:            2 %
SUPPLY DUCT DATA
 Duct Heat Gain................:            2 %
 Duct Leakage Rate.............:            5 %
RETURN PLENUM DATA
 Is a Return Plenum Used.......?            N
SUPPLY FAN DATA
 Fan Type......................:    Backward Inclined or Airfoil
 Configuration.................:    Draw-Thru
 Fan Total Static..............:         2.00 in.wg.
 Fan Efficiency................:           54 %
RETURN FAN DATA
 Fan Type......................:    Backward Inclined or Airfoil
 Fan Total Static..............:         0.25 in.wg.
 Fan Efficiency................:           54 %
OUTDOOR AIR ECONOMIZER
 Outdoor Economizer Type.......:    None
PREHEAT COIL
 Preheat Coil Used.............?            N
PRECOOL COIL
 Precool Coil Used.............?            N
HUMIDIFICATION
 Humidification System Used....?            N
DEHUMIDIFICATION
 Dehumidification System Used..?            N
VENTILATION HEAT RECLAIM
 Reclaim Unit Type.............:    None
SAFETY FACTORS
 Sensible Cooling Factor.......:            0 %
 Latent Cooling Factor.........:            0 %
 Heating Factor................:            0 %
=========================================================================
```

AIR SYSTEM INPUT DATA

Name: AHU-1 Baseline — 08-15-95

Type: CONSTANT VOLUME - Single Zone CAV — HAP v3.04

Prepared by: EINHORN YAFFEE PRESCOTT —

****

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	Skin BB	
Trip Temperature.........(F):	35.0	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	0.0	
Direct Exhaust Fan kW.....(kW):	0.0	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Weekday...............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Saturday..............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sunday................	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Cooling Available During Unoccupied Period ? Y

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Space/Skin Heating.....	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Central Heating........	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	

****

1. SYSTEM NAME AND TYPE

Name............: AHU-2 Baseline
Type............: CONSTANT VOLUME - Multizone
Number of Zones.: 3

==

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA
Cold Deck Temperature.........: 55.0 F
Coil Bypass Factor............: 0.100
Cold Deck Reset...............: Not Used
HEATING SYSTEM DATA
Hot Deck Temperature..........: 110.0 F
Hot Deck Reset................: Not Used
OUTDOOR VENTILATION DATA
Type of Control...............: Constant Airflow Rate
Design Ventilation Airflow....: 4300.0 CFM
Dampers Open During Unocc Per.: N
Damper Leak Rate..............: 2 %
SUPPLY DUCT DATA
Duct Heat Gain................: 2 %
Duct Leakage Rate.............: 5 %
RETURN PLENUM DATA
Is a Return Plenum Used.......? N
SUPPLY FAN DATA
Fan Type......................: Forward Curved
Fan Total Static..............: 2.00 in.wg.
Fan Efficiency................: 54 %
RETURN FAN DATA
Fan Type......................: Backward Inclined or Airfoil
Fan Total Static..............: 0.25 in.wg.
Fan Efficiency................: 54 %
OUTDOOR AIR ECONOMIZER
Outdoor Economizer Type.......: None
PREHEAT COIL
Preheat Coil Used.............? N
PRECOOL COIL
Precool Coil Used.............? N
VENTILATION HEAT RECLAIM
Reclaim Unit Type.............: None
SAFETY FACTORS
Sensible Cooling Factor.......: 0 %
Latent Cooling Factor.........: 0 %
Heating Factor................: 0 %

==

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	None	
Trip Temperature.........(F):	-	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency..........(%):	-	
Zone Terminal Type............:	CAV MBox	
Reheat Coil.................?	N	
Diversity Factor..........(%):	100	
Direct Exhaust Airflow...(CFM):	200.0	
Direct Exhaust Fan kW.....(kW):	0.1	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Weekday................	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Saturday...............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sunday.................	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Cooling Available During Unoccupied Period ? Y

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX		

****

1. SYSTEM NAME AND TYPE

Name............: AHU-3 Baseline
Type............: CONSTANT VOLUME - Single Zone CAV
Number of Zones.: 1

==

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA
Is Central Cooling Used.......? Y
Supply Air....................: 55.0 F
Coil Bypass Factor............: 0.100
Fan Cycled for Cooling........? N
Supply Air Reset..............: Not Used
HEATING SYSTEM DATA
Is Central Heating Used.......? Y
Fan Cycled for Heating........? N
Supply Air Reset..............: Not Used
OUTDOOR VENTILATION DATA
Type of Control...............: Constant Airflow Rate
Design Ventilation Airflow....: 720.0 CFM
Dampers Open During Unocc Per.: N
Damper Leak Rate..............: 2 %
SUPPLY DUCT DATA
Duct Heat Gain................: 2 %
Duct Leakage Rate.............: 5 %
RETURN PLENUM DATA
Is a Return Plenum Used.......? N
SUPPLY FAN DATA
Fan Type......................: Backward Inclined or Airfoil
Configuration.................: Draw-Thru
Fan Total Static..............: 1.50 in.wg.
Fan Efficiency................: 54 %
RETURN FAN DATA
Fan Type......................: Backward Inclined or Airfoil
Fan Total Static..............: 0.25 in.wg.
Fan Efficiency................: 54 %
OUTDOOR AIR ECONOMIZER
Outdoor Economizer Type.......: None
PREHEAT COIL
Preheat Coil Used.............? N
PRECOOL COIL
Precool Coil Used.............? N
HUMIDIFICATION
Humidification System Used....? N
DEHUMIDIFICATION
Dehumidification System Used..? N
VENTILATION HEAT RECLAIM
Reclaim Unit Type.............: None
SAFETY FACTORS
Sensible Cooling Factor.......: 0 %
Latent Cooling Factor.........: 0 %
Heating Factor................: 0 %

==

AIR SYSTEM INPUT DATA

Name: AHU-3 Baseline 08-15-95
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 2

****

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	Skin BB	
Trip Temperature.........(F):	35.0	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type...........:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	900.0	
Direct Exhaust Fan kW.....(kW):	0.1	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Weekday...............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Saturday..............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sunday................	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Cooling Available During Unoccupied Period ? Y

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Space/Skin Heating.....	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Central Heating........	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	

AIR SYSTEM INPUT DATA

Name: AHU-4 Baseline 12-30-94
Type: CONSTANT VOLUME - Multizone HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SYSTEM NAME AND TYPE

Name............: AHU-4 Baseline
Type............: CONSTANT VOLUME - Multizone
Number of Zones.: 7

==

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA
Cold Deck Temperature.........: 55.0 F
Coil Bypass Factor............: 0.100
Cold Deck Reset...............: Not Used
HEATING SYSTEM DATA
Hot Deck Temperature..........: 110.0 F
Hot Deck Reset................: Not Used
OUTDOOR VENTILATION DATA
Type of Control...............: Constant Airflow Rate
Design Ventilation Airflow....: 2160.0 CFM
Dampers Open During Unocc Per.: N
Damper Leak Rate..............: 2 %
SUPPLY DUCT DATA
Duct Heat Gain................: 2 %
Duct Leakage Rate.............: 5 %
RETURN PLENUM DATA
Is a Return Plenum Used.......? N
SUPPLY FAN DATA
Fan Type......................: Forward Curved
Fan Total Static..............: 1.50 in.wg.
Fan Efficiency................: 54 %
RETURN FAN DATA
Fan Type......................: Backward Inclined or Airfoil
Fan Total Static..............: 0.25 in.wg.
Fan Efficiency................: 54 %
OUTDOOR AIR ECONOMIZER
Outdoor Economizer Type.......: None
PREHEAT COIL
Preheat Coil Used.............? N
PRECOOL COIL
Precool Coil Used.............? N
VENTILATION HEAT RECLAIM
Reclaim Unit Type.............: None
SAFETY FACTORS
Sensible Cooling Factor.......: 0 %
Latent Cooling Factor.........: 0 %
Heating Factor................: 0 %

==

3. ZONE DATA

ZONE	1 (All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0
Unoccupied Cooling..(F):	85.0
Occupied Heating....(F):	70.0
Unoccupied Heating..(F):	55.0
Throttling Range....(F):	3.0
Zone Heating Unit Type........:	None
Trip Temperature.........(F):	-
Design Supply Temperature(F):	-
Fan Total Static....(in.wg.):	-
Fan Efficiency...........(%):	-
Zone Terminal Type............:	CAV MBox
Reheat Coil.................?	N
Diversity Factor...........(%):	100
Direct Exhaust Airflow...(CFM):	0.0
Direct Exhaust Fan kW.....(kW):	0.0

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Weekday...............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Saturday..............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sunday................	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Cooling Available During Unoccupied Period ? Y

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX		

****

1. SYSTEM NAME AND TYPE

Name............: AHU-5 Baseline
Type............: CONSTANT VOLUME - Single Zone CAV
Number of Zones.: 1

===

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA
 Is Central Cooling Used.......? Y
 Supply Air....................: 55.0 F
 Coil Bypass Factor............: 0.100
 Fan Cycled for Cooling........? N
 Supply Air Reset..............: Not Used
HEATING SYSTEM DATA
 Is Central Heating Used.......? Y
 Fan Cycled for Heating........? N
 Supply Air Reset..............: Not Used
OUTDOOR VENTILATION DATA
 Type of Control...............: Constant Airflow Rate
 Design Ventilation Airflow....: 960.0 CFM
 Dampers Open During Unocc Per.: N
 Damper Leak Rate..............: 2 %
SUPPLY DUCT DATA
 Duct Heat Gain................: 2 %
 Duct Leakage Rate.............: 5 %
RETURN PLENUM DATA
 Is a Return Plenum Used.......? N
SUPPLY FAN DATA
 Fan Type......................: Forward Curved
 Configuration.................: Draw-Thru
 Fan Total Static..............: 1.50 in.wg.
 Fan Efficiency................: 54 %
RETURN FAN DATA
 Fan Type......................: Backward Inclined or Airfoil
 Fan Total Static..............: 0.25 in.wg.
 Fan Efficiency................: 54 %
OUTDOOR AIR ECONOMIZER
 Outdoor Economizer Type.......: None
PREHEAT COIL
 Preheat Coil Used.............? N
PRECOOL COIL
 Precool Coil Used.............? N
HUMIDIFICATION
 Humidification System Used....? N
DEHUMIDIFICATION
 Dehumidification System Used..? N
VENTILATION HEAT RECLAIM
 Reclaim Unit Type.............: None
SAFETY FACTORS
 Sensible Cooling Factor.......: 0 %
 Latent Cooling Factor.........: 0 %
 Heating Factor................: 0 %

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3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	Skin BB	
Trip Temperature.........(F):	35.0	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	0.0	
Direct Exhaust Fan kW.....(kW):	0.0	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Weekday...............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Saturday..............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sunday................	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Cooling Available During Unoccupied Period ? Y

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Space/Skin Heating.....	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Central Heating........	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	

```
                         AIR SYSTEM INPUT DATA
Name: AHU-6 Baseline                                          12-30-94
Type: CONSTANT VOLUME - Single Zone CAV                       HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT                          Page  1
************************************************************************

1. SYSTEM NAME AND TYPE
------------------------------------------------------------------------
  Name............: AHU-6 Baseline
  Type............: CONSTANT VOLUME - Single Zone CAV
  Number of Zones.:  1
========================================================================

2. SYSTEM DESCRIPTION
------------------------------------------------------------------------
COOLING SYSTEM DATA
 Is Central Cooling Used.......?              N
HEATING SYSTEM DATA
 Supply Air Temperature........?          110.0 F
 Fan Cycled for Heating........?              N
 Supply Air Reset..............:     Not Used
OUTDOOR VENTILATION DATA
 Type of Control...............:     Constant Airflow Rate
 Design Ventilation Airflow....:            100 %
 Dampers Open During Unocc Per.:              N
 Damper Leak Rate..............:              2 %
SUPPLY DUCT DATA
 Duct Heat Gain................:              2 %
 Duct Leakage Rate.............:              5 %
RETURN PLENUM DATA
 Is a Return Plenum Used.......?              N
SUPPLY FAN DATA
 Fan Type......................:     Forward Curved
 Configuration.................:     Draw-Thru
 Fan Total Static..............:           1.00 in.wg.
 Fan Efficiency................:             54 %
RETURN FAN DATA
 Fan Type......................:     None
OUTDOOR AIR ECONOMIZER
 Outdoor Economizer Type.......:     None
PREHEAT COIL
 Preheat Coil Used.............?              N
PRECOOL COIL
 Precool Coil Used.............?              N
HUMIDIFICATION
 Humidification System Used....?              N
VENTILATION HEAT RECLAIM
 Reclaim Unit Type.............:     None
SAFETY FACTORS
 Sensible Cooling Factor.......:              0 %
 Latent Cooling Factor.........:              0 %
 Heating Factor................:              0 %
========================================================================
```

3. ZONE DATA

ZONE	1 (All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0
Unoccupied Cooling..(F):	85.0
Occupied Heating....(F):	70.0
Unoccupied Heating..(F):	55.0
Throttling Range....(F):	3.0
Zone Heating Unit Type........:	Skin BB
Trip Temperature.........(F):	35.0
Design Supply Temperature(F):	-
Fan Total Static....(in.wg.):	-
Fan Efficiency...........(%):	-
Zone Terminal Type............:	Diffuser
Reheat Coil.................?	N
Direct Exhaust Airflow...(CFM):	5400.0
Direct Exhaust Fan kW.....(kW):	1.4

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Weekday................	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Saturday...............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sunday.................	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Space/Skin Heating.....	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Central Heating........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	

AIR SYSTEM INPUT DATA

****

1. SYSTEM NAME AND TYPE

```
 Name............: AHU-1  PLC
 Type............: CONSTANT VOLUME - Single Zone CAV
 Number of Zones.:  1
```

2. SYSTEM DESCRIPTION

```
COOLING SYSTEM DATA
 Is Central Cooling Used.......?          Y
 Supply Air....................:       55.0 F
 Coil Bypass Factor............:      0.100
 Fan Cycled for Cooling........?          N
 Supply Air Reset..............:   Not Used
HEATING SYSTEM DATA
 Is Central Heating Used.......?          Y
 Fan Cycled for Heating........?          N
 Supply Air Reset..............:   Not Used
OUTDOOR VENTILATION DATA
 Type of Control...............:   Constant Airflow Rate
 Design Ventilation Airflow....:     2135.0 CFM
 Dampers Open During Unocc Per.:          N
 Damper Leak Rate..............:          2 %
SUPPLY DUCT DATA
 Duct Heat Gain................:          2 %
 Duct Leakage Rate.............:          5 %
RETURN PLENUM DATA
 Is a Return Plenum Used.......?          N
SUPPLY FAN DATA
 Fan Type......................:   Backward Inclined or Airfoil
 Configuration.................:   Draw-Thru
 Fan Total Static..............:       2.00 in.wg.
 Fan Efficiency................:         54 %
RETURN FAN DATA
 Fan Type......................:   Backward Inclined or Airfoil
 Fan Total Static..............:       0.25 in.wg.
 Fan Efficiency................:         54 %
OUTDOOR AIR ECONOMIZER
 Outdoor Economizer Type.......:   None
PREHEAT COIL
 Preheat Coil Used.............?          N
PRECOOL COIL
 Precool Coil Used.............?          N
HUMIDIFICATION
 Humidification System Used....?          N
DEHUMIDIFICATION
 Dehumidification System Used..?          N
VENTILATION HEAT RECLAIM
 Reclaim Unit Type.............:   None
SAFETY FACTORS
 Sensible Cooling Factor.......:          0 %
 Latent Cooling Factor.........:          0 %
 Heating Factor................:          0 %
```

AIR SYSTEM INPUT DATA

Name: AHU-1 PLC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT

****

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	Skin BB	
Trip Temperature.........(F):	35.0	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	0.0	
Direct Exhaust Fan kW.....(kW):	0.0	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Weekday................								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Saturday...............													X	X	X	X	X	X	X	X	X	X	X	
Sunday.................											X	X	X	X	X	X	X	X	X					

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Space/Skin Heating.....	XXX	XXX	XXX							XXX	XXX	XXX
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX		

AIR SYSTEM INPUT DATA

****

1. SYSTEM NAME AND TYPE

Name............: AHU-2 PLC
Type............: CONSTANT VOLUME - Multizone
Number of Zones.: 3

===

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA
Cold Deck Temperature.........: 55.0 F
Coil Bypass Factor............: 0.100
Cold Deck Reset...............: Not Used
HEATING SYSTEM DATA
Hot Deck Temperature..........: 110.0 F
Hot Deck Reset................: Not Used
OUTDOOR VENTILATION DATA
Type of Control...............: Constant Airflow Rate
Design Ventilation Airflow....: 4300.0 CFM
Dampers Open During Unocc Per.: N
Damper Leak Rate..............: 2 %
SUPPLY DUCT DATA
Duct Heat Gain................: 2 %
Duct Leakage Rate.............: 5 %
RETURN PLENUM DATA
Is a Return Plenum Used.......? N
SUPPLY FAN DATA
Fan Type......................: Forward Curved
Fan Total Static..............: 2.00 in.wg.
Fan Efficiency................: 54 %
RETURN FAN DATA
Fan Type......................: Backward Inclined or Airfoil
Fan Total Static..............: 0.25 in.wg.
Fan Efficiency................: 54 %
OUTDOOR AIR ECONOMIZER
Outdoor Economizer Type.......: None
PREHEAT COIL
Preheat Coil Used.............? N
PRECOOL COIL
Precool Coil Used.............? N
VENTILATION HEAT RECLAIM
Reclaim Unit Type.............: None
SAFETY FACTORS
Sensible Cooling Factor.......: 0 %
Latent Cooling Factor.........: 0 %
Heating Factor................: 0 %

===

Name: AHU-2 PLC | 12-30-94
Type: CONSTANT VOLUME - Multizone | HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT |

3. ZONE DATA

ZONE	1 (All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0
Unoccupied Cooling..(F):	85.0
Occupied Heating....(F):	70.0
Unoccupied Heating..(F):	55.0
Throttling Range....(F):	3.0
Zone Heating Unit Type........:	None
Trip Temperature.........(F):	-
Design Supply Temperature(F):	-
Fan Total Static....(in.wg.):	-
Fan Efficiency...........(%):	-
Zone Terminal Type............:	CAV MBox
Reheat Coil.................?	N
Diversity Factor...........(%):	100
Direct Exhaust Airflow...(CFM):	200.0
Direct Exhaust Fan kW.....(kW):	0.1

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Weekday................								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Saturday...............													X	X	X	X	X	X	X	X	X	X	X	
Sunday.................											X	X	X	X	X	X	X	X	X					

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX		

[illegible] allowing cooling & heating [illegible] overlap? Is this the reason for higher cooling loads [illegible] on pg D[illegible]?

AIR SYSTEM INPUT DATA

Name: AHU-3 PLC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SYSTEM NAME AND TYPE

```
  Name............: AHU-3  PLC
  Type............: CONSTANT VOLUME - Single Zone CAV
  Number of Zones.:  1
```

===

2. SYSTEM DESCRIPTION

```
COOLING SYSTEM DATA
 Is Central Cooling Used.......?           Y
 Supply Air....................:        55.0 F
 Coil Bypass Factor............:       0.100
 Fan Cycled for Cooling........?           N
 Supply Air Reset..............:    Not Used
HEATING SYSTEM DATA
 Is Central Heating Used.......?           Y
 Fan Cycled for Heating........?           N
 Supply Air Reset..............:    Not Used
OUTDOOR VENTILATION DATA
 Type of Control...............:    Constant Airflow Rate
 Design Ventilation Airflow....:       720.0 CFM
 Dampers Open During Unocc Per.:           N
 Damper Leak Rate..............:           2 %
SUPPLY DUCT DATA
 Duct Heat Gain................:           2 %
 Duct Leakage Rate.............:           5 %
RETURN PLENUM DATA
 Is a Return Plenum Used.......?           N
SUPPLY FAN DATA
 Fan Type......................:    Backward Inclined or Airfoil
 Configuration.................:    Draw-Thru
 Fan Total Static..............:        1.50 in.wg.
 Fan Efficiency................:          54 %
RETURN FAN DATA
 Fan Type......................:    Backward Inclined or Airfoil
 Fan Total Static..............:        0.25 in.wg.
 Fan Efficiency................:          54 %
OUTDOOR AIR ECONOMIZER
 Outdoor Economizer Type.......:    None
PREHEAT COIL
 Preheat Coil Used.............?           N
PRECOOL COIL
 Precool Coil Used.............?           N
HUMIDIFICATION
 Humidification System Used....?           N
DEHUMIDIFICATION
 Dehumidification System Used..?           N
VENTILATION HEAT RECLAIM
 Reclaim Unit Type.............:    None
SAFETY FACTORS
 Sensible Cooling Factor.......:           0 %
 Latent Cooling Factor.........:           0 %
 Heating Factor................:           0 %
```

===

AIR SYSTEM INPUT DATA

Name: AHU-3 PLC — 12-30-94

Type: CONSTANT VOLUME - Single Zone CAV — HAP v3.04

Prepared by: EINHORN YAFFEE PRESCOTT —

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	Skin BB	
Trip Temperature.........(F):	35.0	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	900.0	
Direct Exhaust Fan kW.....(kW):	0.1	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Weekday...............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Saturday..............													X	X	X	X	X	X	X	X	X	X	X	
Sunday................											X	X	X	X	X	X	X	X	X					

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Space/Skin Heating.....	XXX	XXX	XXX							XXX	XXX	XXX
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX		

AIR SYSTEM INPUT DATA

Name: AHU-4 PLC 12-30-94
Type: CONSTANT VOLUME - Multizone HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SYSTEM NAME AND TYPE

Name............: AHU-4 PLC
Type............: CONSTANT VOLUME - Multizone
Number of Zones.: 7

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA	
Cold Deck Temperature.........:	55.0 F
Coil Bypass Factor............:	0.100
Cold Deck Reset...............:	Not Used
HEATING SYSTEM DATA	
Hot Deck Temperature..........:	110.0 F
Hot Deck Reset................:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control...............:	Constant Airflow Rate
Design Ventilation Airflow....:	2160.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate..............:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain................:	2 %
Duct Leakage Rate.............:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used.......?	N
SUPPLY FAN DATA	
Fan Type......................:	Forward Curved
Fan Total Static..............:	1.50 in.wg.
Fan Efficiency................:	54 %
RETURN FAN DATA	
Fan Type......................:	Backward Inclined or Airfoil
Fan Total Static..............:	0.25 in.wg.
Fan Efficiency................:	54 %
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type.......:	None
PREHEAT COIL	
Preheat Coil Used.............?	N
PRECOOL COIL	
Precool Coil Used.............?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type.............:	None
SAFETY FACTORS	
Sensible Cooling Factor.......:	0 %
Latent Cooling Factor.........:	0 %
Heating Factor................:	0 %

AIR SYSTEM INPUT DATA

Name: AHU-4 PLC — 12-30-94
Type: CONSTANT VOLUME - Multizone — HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT — Page 2

****

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	None	
Trip Temperature.........(F):	-	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	CAV MBox	
Reheat Coil.................?	N	
Diversity Factor...........(%):	100	
Direct Exhaust Airflow...(CFM):	0.0	
Direct Exhaust Fan kW.....(kW):	0.0	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Weekday................								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Saturday...............													X	X	X	X	X	X	X	X	X	X	X	
Sunday.................											X	X	X	X	X	X	X	X	X					

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX		

C-44

AIR SYSTEM INPUT DATA

Name: AHU-5 PLC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SYSTEM NAME AND TYPE

Name............: AHU-5 PLC
Type............: CONSTANT VOLUME - Single Zone CAV
Number of Zones.: 1

===

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA
Is Central Cooling Used.......? Y
Supply Air....................: 55.0 F
Coil Bypass Factor............: 0.100
Fan Cycled for Cooling........? N
Supply Air Reset..............: Not Used
HEATING SYSTEM DATA
Is Central Heating Used.......? Y
Fan Cycled for Heating........? N
Supply Air Reset..............: Not Used
OUTDOOR VENTILATION DATA
Type of Control...............: Constant Airflow Rate
Design Ventilation Airflow....: 960.0 CFM
Dampers Open During Unocc Per.: N
Damper Leak Rate..............: 2 %
SUPPLY DUCT DATA
Duct Heat Gain................: 2 %
Duct Leakage Rate.............: 5 %
RETURN PLENUM DATA
Is a Return Plenum Used.......? N
SUPPLY FAN DATA
Fan Type......................: Forward Curved
Configuration.................: Draw-Thru
Fan Total Static..............: 1.50 in.wg.
Fan Efficiency................: 54 %
RETURN FAN DATA
Fan Type......................: Backward Inclined or Airfoil
Fan Total Static..............: 0.25 in.wg.
Fan Efficiency................: 54 %
OUTDOOR AIR ECONOMIZER
Outdoor Economizer Type.......: None
PREHEAT COIL
Preheat Coil Used.............? N
PRECOOL COIL
Precool Coil Used.............? N
HUMIDIFICATION
Humidification System Used....? N
DEHUMIDIFICATION
Dehumidification System Used..? N
VENTILATION HEAT RECLAIM
Reclaim Unit Type.............: None
SAFETY FACTORS
Sensible Cooling Factor.......: 0 %
Latent Cooling Factor.........: 0 %
Heating Factor................: 0 %

===

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	Skin BB	
Trip Temperature.........(F):	35.0	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	0.0	
Direct Exhaust Fan kW.....(kW):	0.0	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Weekday...............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Saturday..............													X	X	X	X	X	X	X	X	X	X	X	
Sunday................											X	X	X	X	X	X	X	X	X					

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Space/Skin Heating.....	XXX	XXX	XXX							XXX	XXX	XXX
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX		

AIR SYSTEM INPUT DATA

1. SYSTEM NAME AND TYPE

Name............:	AHU-6 PLC
Type............:	CONSTANT VOLUME - Single Zone CAV
Number of Zones.:	1

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA	
Is Central Cooling Used.......?	N
HEATING SYSTEM DATA	
Supply Air Temperature........?	110.0 F
Fan Cycled for Heating........?	N
Supply Air Reset..............:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control...............:	Constant Airflow Rate
Design Ventilation Airflow....:	100 %
Dampers Open During Unocc Per.:	N
Damper Leak Rate..............:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain................:	2 %
Duct Leakage Rate.............:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used.......?	N
SUPPLY FAN DATA	
Fan Type......................:	Forward Curved
Configuration.................:	Draw-Thru
Fan Total Static..............:	1.00 in.wg.
Fan Efficiency................:	54 %
RETURN FAN DATA	
Fan Type......................:	None
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type.......:	None
PREHEAT COIL	
Preheat Coil Used.............?	N
PRECOOL COIL	
Precool Coil Used.............?	N
HUMIDIFICATION	
Humidification System Used....?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type.............:	None
SAFETY FACTORS	
Sensible Cooling Factor.......:	0 %
Latent Cooling Factor.........:	0 %
Heating Factor................:	0 %

AIR SYSTEM INPUT DATA

Name: AHU-6 PLC — 12-30-94

Type: CONSTANT VOLUME - Single Zone CAV — HAP v3.04

Prepared by: EINHORN YAFFEE PRESCOTT —

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	Skin BB	
Trip Temperature.........(F):	35.0	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	5400.0	
Direct Exhaust Fan kW.....(kW):	1.4	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Weekday................								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Saturday...............													X	X	X	X	X	X	X	X	X	X	X	
Sunday.................											X	X	X	X	X	X	X	X	X					

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Space/Skin Heating.....	XXX	XXX	XXX							XXX	XXX	XXX
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX

AIR SYSTEM INPUT DATA

Name: AHU-1 DDC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SYSTEM NAME AND TYPE

Name............: AHU-1 DDC
Type............: CONSTANT VOLUME - Single Zone CAV
Number of Zones.: 1

==

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA
Is Central Cooling Used.......? Y
Supply Air....................: 55.0 F
Coil Bypass Factor............: 0.100
Fan Cycled for Cooling........? N
Supply Air Reset..............: Not Used
HEATING SYSTEM DATA
Is Central Heating Used.......? Y
Fan Cycled for Heating........? N
Supply Air Reset..............: Not Used
OUTDOOR VENTILATION DATA
Type of Control...............: Constant Airflow Rate
Design Ventilation Airflow....: 2135.0 CFM
Dampers Open During Unocc Per.: N
Damper Leak Rate..............: 2 %
SUPPLY DUCT DATA
Duct Heat Gain................: 2 %
Duct Leakage Rate.............: 5 %
RETURN PLENUM DATA
Is a Return Plenum Used.......? N
SUPPLY FAN DATA
Fan Type......................: Backward Inclined or Airfoil
Configuration.................: Draw-Thru
Fan Total Static..............: 2.00 in.wg.
Fan Efficiency................: 54 %
RETURN FAN DATA
Fan Type......................: Backward Inclined or Airfoil
Fan Total Static..............: 0.25 in.wg.
Fan Efficiency................: 54 %
OUTDOOR AIR ECONOMIZER
Outdoor Economizer Type.......: Integrated Enthalpy
OA Upper Cutoff Temp..........: 95.0 F
OA Lower Cutoff Temp..........: 0.0 F
PREHEAT COIL
Preheat Coil Used.............? N
PRECOOL COIL
Precool Coil Used.............? N
HUMIDIFICATION
Humidification System Used....? N
DEHUMIDIFICATION
Dehumidification System Used..? N
VENTILATION HEAT RECLAIM
Reclaim Unit Type.............: None

==

AIR SYSTEM INPUT DATA

Name: AHU-1 DDC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT

****

2. SYSTEM DESCRIPTION (CONTINUED)

SAFETY FACTORS

Sensible Cooling Factor.......:	0 %
Latent Cooling Factor.........:	0 %
Heating Factor................:	0 %

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	Skin BB	
Trip Temperature.........(F):	35.0	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	0.0	
Direct Exhaust Fan kW.....(kW):	0.0	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Weekday...............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Saturday..............													X	X	X	X	X	X	X	X	X	X	X	
Sunday................											X	X	X	X	X	X	X	X	X					

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Space/Skin Heating.....	XXX	XXX	XXX							XXX	XXX	XXX
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX		

AIR SYSTEM INPUT DATA

****

1. SYSTEM NAME AND TYPE

Name............: AHU-2 DDC
Type............: CONSTANT VOLUME - Multizone
Number of Zones.: 3

==

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA
Cold Deck Temperature.........: 55.0 F
Coil Bypass Factor............: 0.100
Cold Deck Reset...............: Greatest Demand
Maximum Reset Temperature.....: 60.0 F
HEATING SYSTEM DATA
Hot Deck Temperature..........: 110.0 F
Hot Deck Reset................: Greatest Demand
Minimum Reset Temperature.....: 90.0 F
OUTDOOR VENTILATION DATA
Type of Control...............: Constant Airflow Rate
Design Ventilation Airflow....: 4300.0 CFM
Dampers Open During Unocc Per.: N
Damper Leak Rate..............: 2 %
SUPPLY DUCT DATA
Duct Heat Gain................: 2 %
Duct Leakage Rate.............: 5 %
RETURN PLENUM DATA
Is a Return Plenum Used.......? N
SUPPLY FAN DATA
Fan Type......................: Forward Curved
Fan Total Static..............: 2.00 in.wg.
Fan Efficiency................: 54 %
RETURN FAN DATA
Fan Type......................: Backward Inclined or Airfoil
Fan Total Static..............: 0.25 in.wg.
Fan Efficiency................: 54 %
OUTDOOR AIR ECONOMIZER
Outdoor Economizer Type.......: Integrated Enthalpy
OA Upper Cutoff Temp..........: 95.0 F
OA Lower Cutoff Temp..........: 0.0 F
PREHEAT COIL
Preheat Coil Used.............? N
PRECOOL COIL
Precool Coil Used.............? N
VENTILATION HEAT RECLAIM
Reclaim Unit Type.............: None
SAFETY FACTORS
Sensible Cooling Factor.......: 0 %
Latent Cooling Factor.........: 0 %
Heating Factor................: 0 %

==

AIR SYSTEM INPUT DATA

Name: AHU-2 DDC 12-30-94
Type: CONSTANT VOLUME - Multizone HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 2

****

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	None	
Trip Temperature.........(F):	-	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	CAV MBox	
Reheat Coil.................?	N	
Diversity Factor..........(%):	100	
Direct Exhaust Airflow...(CFM):	200.0	
Direct Exhaust Fan kW.....(kW):	0.1	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Weekday...............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Saturday..............													X	X	X	X	X	X	X	X	X	X	X	
Sunday................											X	X	X	X	X	X	X	X	X					

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX		

****

1. SYSTEM NAME AND TYPE

Name............: AHU-3 DDC
Type............: CONSTANT VOLUME - Single Zone CAV
Number of Zones.: 1

==

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA
Is Central Cooling Used.......? Y
Supply Air....................: 55.0 F
Coil Bypass Factor............: 0.100
Fan Cycled for Cooling........? N
Supply Air Reset..............: Not Used
HEATING SYSTEM DATA
Is Central Heating Used.......? Y
Fan Cycled for Heating........? N
Supply Air Reset..............: Not Used
OUTDOOR VENTILATION DATA
Type of Control...............: Constant Airflow Rate
Design Ventilation Airflow....: 720.0 CFM
Dampers Open During Unocc Per.: N
Damper Leak Rate..............: 2 %
SUPPLY DUCT DATA
Duct Heat Gain................: 2 %
Duct Leakage Rate.............: 5 %
RETURN PLENUM DATA
Is a Return Plenum Used.......? N
SUPPLY FAN DATA
Fan Type......................: Backward Inclined or Airfoil
Configuration.................: Draw-Thru
Fan Total Static..............: 1.50 in.wg.
Fan Efficiency................: 54 %
RETURN FAN DATA
Fan Type......................: Backward Inclined or Airfoil
Fan Total Static..............: 0.25 in.wg.
Fan Efficiency................: 54 %
OUTDOOR AIR ECONOMIZER
Outdoor Economizer Type.......: Integrated Enthalpy
OA Upper Cutoff Temp..........: 95.0 F
OA Lower Cutoff Temp..........: 0.0 F
PREHEAT COIL
Preheat Coil Used.............? N
PRECOOL COIL
Precool Coil Used.............? N
HUMIDIFICATION
Humidification System Used....? N
DEHUMIDIFICATION
Dehumidification System Used..? N
VENTILATION HEAT RECLAIM
Reclaim Unit Type.............: None

==

AIR SYSTEM INPUT DATA

Name: AHU-3 DDC — 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV — HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT — Page 2

****

2. SYSTEM DESCRIPTION (CONTINUED)

SAFETY FACTORS

Sensible Cooling Factor.......:	0 %
Latent Cooling Factor.........:	0 %
Heating Factor................:	0 %

3. ZONE DATA

ZONE	1 (All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0
Unoccupied Cooling..(F):	85.0
Occupied Heating....(F):	70.0
Unoccupied Heating..(F):	55.0
Throttling Range....(F):	3.0
Zone Heating Unit Type........:	Skin BB
Trip Temperature.........(F):	35.0
Design Supply Temperature(F):	-
Fan Total Static....(in.wg.):	-
Fan Efficiency...........(%):	-
Zone Terminal Type............:	Diffuser
Reheat Coil.................?	N
Direct Exhaust Airflow...(CFM):	900.0
Direct Exhaust Fan kW.....(kW):	0.1

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Weekday...............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Saturday..............													X	X	X	X	X	X	X	X	X	X	X	
Sunday................											X	X	X	X	X	X	X	X	X					

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Space/Skin Heating.....	XXX	XXX	XXX							XXX	XXX	XXX
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX		

AIR SYSTEM INPUT DATA

1. SYSTEM NAME AND TYPE

Name............:	AHU-4 DDC
Type............:	CONSTANT VOLUME - Multizone
Number of Zones.:	7

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA	
Cold Deck Temperature.........:	55.0 F
Coil Bypass Factor............:	0.100
Cold Deck Reset...............:	Greatest Demand
Maximum Reset Temperature.....:	60.0 F
HEATING SYSTEM DATA	
Hot Deck Temperature..........:	110.0 F
Hot Deck Reset................:	Greatest Demand
Minimum Reset Temperature.....:	90.0 F
OUTDOOR VENTILATION DATA	
Type of Control...............:	Constant Airflow Rate
Design Ventilation Airflow....:	2160.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate..............:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain................:	2 %
Duct Leakage Rate.............:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used.......?	N
SUPPLY FAN DATA	
Fan Type......................:	Forward Curved
Fan Total Static..............:	1.50 in.wg.
Fan Efficiency................:	54 %
RETURN FAN DATA	
Fan Type......................:	Backward Inclined or Airfoil
Fan Total Static..............:	0.25 in.wg.
Fan Efficiency................:	54 %
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type.......:	Integrated Enthalpy
OA Upper Cutoff Temp..........:	95.0 F
OA Lower Cutoff Temp..........:	0.0 F
PREHEAT COIL	
Preheat Coil Used.............?	N
PRECOOL COIL	
Precool Coil Used.............?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type.............:	None
SAFETY FACTORS	
Sensible Cooling Factor.......:	0 %
Latent Cooling Factor.........:	0 %
Heating Factor................:	0 %

AIR SYSTEM INPUT DATA

Name: AHU-4 DDC — 12-30-94
Type: CONSTANT VOLUME - Multizone — HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT — Page 2

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3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	None	
Trip Temperature.........(F):	-	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	CAV MBox	
Reheat Coil.................?	N	
Diversity Factor...........(%):	100	
Direct Exhaust Airflow...(CFM):	0.0	
Direct Exhaust Fan kW.....(kW):	0.0	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Weekday................								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Saturday...............													X	X	X	X	X	X	X	X	X	X	X	
Sunday.................											X	X	X	X	X	X	X	X	X					

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX		

AIR SYSTEM INPUT DATA

1. SYSTEM NAME AND TYPE

Name............: AHU-5 DDC
Type............: CONSTANT VOLUME - Single Zone CAV
Number of Zones.: 1

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA	
Is Central Cooling Used.......?	Y
Supply Air....................:	55.0 F
Coil Bypass Factor............:	0.100
Fan Cycled for Cooling........?	N
Supply Air Reset..............:	Not Used
HEATING SYSTEM DATA	
Is Central Heating Used.......?	Y
Fan Cycled for Heating........?	N
Supply Air Reset..............:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control...............:	Constant Airflow Rate
Design Ventilation Airflow....:	960.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate..............:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain................:	2 %
Duct Leakage Rate.............:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used.......?	N
SUPPLY FAN DATA	
Fan Type......................:	Forward Curved
Configuration.................:	Draw-Thru
Fan Total Static..............:	1.50 in.wg.
Fan Efficiency................:	54 %
RETURN FAN DATA	
Fan Type......................:	Backward Inclined or Airfoil
Fan Total Static..............:	0.25 in.wg.
Fan Efficiency................:	54 %
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type.......:	Integrated Enthalpy
OA Upper Cutoff Temp..........:	95.0 F
OA Lower Cutoff Temp..........:	0.0 F
PREHEAT COIL	
Preheat Coil Used.............?	N
PRECOOL COIL	
Precool Coil Used.............?	N
HUMIDIFICATION	
Humidification System Used....?	N
DEHUMIDIFICATION	
Dehumidification System Used..?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type.............:	None

AIR SYSTEM INPUT DATA

Name: AHU-5 DDC — 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV — HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT — Page 2

2. SYSTEM DESCRIPTION (CONTINUED)

SAFETY FACTORS

Sensible Cooling Factor.......:	0 %
Latent Cooling Factor.........:	0 %
Heating Factor................:	0 %

3. ZONE DATA

ZONE	1 (All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0
Unoccupied Cooling..(F):	85.0
Occupied Heating....(F):	70.0
Unoccupied Heating..(F):	55.0
Throttling Range....(F):	3.0
Zone Heating Unit Type........:	Skin BB
Trip Temperature.........(F):	35.0
Design Supply Temperature(F):	-
Fan Total Static....(in.wg.):	-
Fan Efficiency...........(%):	-
Zone Terminal Type............:	Diffuser
Reheat Coil.................?	N
Direct Exhaust Airflow...(CFM):	0.0
Direct Exhaust Fan kW.....(kW):	0.0

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Weekday................								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Saturday...............													X	X	X	X	X	X	X	X	X	X	X	
Sunday.................											X	X	X	X	X	X	X	X	X					

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Space/Skin Heating.....	XXX	XXX	XXX							XXX	XXX	XXX
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX
Central Cooling........			XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX		

AIR SYSTEM INPUT DATA

Name: AHU-6 DDC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT

***

1. SYSTEM NAME AND TYPE

Name............: AHU-6 DDC
Type............: CONSTANT VOLUME - Single Zone CAV
Number of Zones.: 1

===

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA
Is Central Cooling Used.......? N
HEATING SYSTEM DATA
Supply Air Temperature........? 110.0 F
Fan Cycled for Heating........? N
Supply Air Reset..............: Not Used
OUTDOOR VENTILATION DATA
Type of Control...............: Constant Airflow Rate
Design Ventilation Airflow....: 100 %
Dampers Open During Unocc Per.: N
Damper Leak Rate..............: 2 %
SUPPLY DUCT DATA
Duct Heat Gain................: 2 %
Duct Leakage Rate.............: 5 %
RETURN PLENUM DATA
Is a Return Plenum Used.......? N
SUPPLY FAN DATA
Fan Type......................: Forward Curved
Configuration.................: Draw-Thru
Fan Total Static..............: 1.00 in.wg.
Fan Efficiency................: 54 %
RETURN FAN DATA
Fan Type......................: None
OUTDOOR AIR ECONOMIZER
Outdoor Economizer Type.......: None
PREHEAT COIL
Preheat Coil Used.............? N
PRECOOL COIL
Precool Coil Used.............? N
HUMIDIFICATION
Humidification System Used....? N
VENTILATION HEAT RECLAIM
Reclaim Unit Type.............: None
SAFETY FACTORS
Sensible Cooling Factor.......: 0 %
Latent Cooling Factor.........: 0 %
Heating Factor................: 0 %

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AIR SYSTEM INPUT DATA

Name: AHU-6 DDC	12-30-94
Type: CONSTANT VOLUME - Single Zone CAV	HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT	Page 2

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	Skin BB	
Trip Temperature.........(F):	35.0	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type...........:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	5400.0	
Direct Exhaust Fan kW.....(kW):	1.4	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Weekday................								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Saturday...............													X	X	X	X	X	X	X	X	X	X	X	
Sunday.................											X	X	X	X	X	X	X	X	X					

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Space/Skin Heating.....	XXX	XXX	XXX							XXX	XXX	XXX
Central Heating........	XXX	XXX	XXX	XXX					XXX	XXX	XXX	XXX

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
2. AHU-1 Assembly / Travel	1		

AIR SYSTEM INPUT DATA

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
3. AHU 2-1 Multi-Purpose	1		
SPACES IN ZONE 2 (Zone 2)			
4. AHU 2-2 Stage	1		
SPACES IN ZONE 3 (Zone 3)			
5. AHU 2-3 Multi-Purpose	1		

AIR SYSTEM INPUT DATA

Name: AHU-3 Baseline 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT

****

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
6. AHU 3 Concourse	1		

AIR SYSTEM INPUT DATA

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
7. AHU 4-1 Music Room	1		
SPACES IN ZONE 2 (Zone 2)			
8. AHU 4-2 TV Room	1		
SPACES IN ZONE 3 (Zone 3)			
9. AHU 4-3 Mini Auditorium	1		
SPACES IN ZONE 4 (Zone 4)			
10. AHU 4-4 Crafts Room	1		
SPACES IN ZONE 5 (Zone 5)			
11. AHU 4-5 Reading Room	1		
SPACES IN ZONE 6 (Zone 6)			
12. AHU 4-6 Office	1		
SPACES IN ZONE 7 (Zone 7)			
13. AHU 4-7 Offices	1		

AIR SYSTEM INPUT DATA

****

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
14. AHU 5 Acivity Room	1		

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
15. AHU 6 Travel / Kitchen	1		

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
2. AHU-1 Assembly / Travel	1		

AIR SYSTEM INPUT DATA

Name: AHU-2 PLC 12-30-94
Type: CONSTANT VOLUME - Multizone HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
3. AHU 2-1 Multi-Purpose	1		
SPACES IN ZONE 2 (Zone 2)			
4. AHU 2-2 Stage	1		
SPACES IN ZONE 3 (Zone 3)			
5. AHU 2-3 Multi-Purpose	1		

AIR SYSTEM INPUT DATA

Name: AHU-3 PLC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
6. AHU 3 Concourse	1		

AIR SYSTEM INPUT DATA

Name: AHU-4 PLC 12-30-94
Type: CONSTANT VOLUME - Multizone HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
7. AHU 4-1 Music Room	1		
SPACES IN ZONE 2 (Zone 2)			
8. AHU 4-2 TV Room	1		
SPACES IN ZONE 3 (Zone 3)			
9. AHU 4-3 Mini Auditorium	1		
SPACES IN ZONE 4 (Zone 4)			
10. AHU 4-4 Crafts Room	1		
SPACES IN ZONE 5 (Zone 5)			
11. AHU 4-5 Reading Room	1		
SPACES IN ZONE 6 (Zone 6)			
12. AHU 4-6 Office	1		
SPACES IN ZONE 7 (Zone 7)			
13. AHU 4-7 Offices	1		

AIR SYSTEM INPUT DATA

Name: AHU-5 PLC
12-30-94

Type: CONSTANT VOLUME - Single Zone CAV
HAP v3.04

Prepared by: EINHORN YAFFEE PRESCOTT

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
14. AHU 5 Acivity Room	1		

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
15. AHU 6 Travel / Kitchen	1		

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
2. AHU-1 Assembly / Travel	1		

AIR SYSTEM INPUT DATA

Name: AHU-2 DDC 12-30-94
Type: CONSTANT VOLUME - Multizone HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT

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1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
3. AHU 2-1 Multi-Purpose	1		
SPACES IN ZONE 2 (Zone 2)			
4. AHU 2-2 Stage	1		
SPACES IN ZONE 3 (Zone 3)			
5. AHU 2-3 Multi-Purpose	1		

AIR SYSTEM INPUT DATA

Name: AHU-3 DDC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
6. AHU 3 Concourse	1		

AIR SYSTEM INPUT DATA

Name: AHU-4 DDC
Type: CONSTANT VOLUME - Multizone
Prepared by: EINHORN YAFFEE PRESCOTT

****

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
7. AHU 4-1 Music Room	1		
SPACES IN ZONE 2 (Zone 2)			
8. AHU 4-2 TV Room	1		
SPACES IN ZONE 3 (Zone 3)			
9. AHU 4-3 Mini Auditorium	1		
SPACES IN ZONE 4 (Zone 4)			
10. AHU 4-4 Crafts Room	1		
SPACES IN ZONE 5 (Zone 5)			
11. AHU 4-5 Reading Room	1		
SPACES IN ZONE 6 (Zone 6)			
12. AHU 4-6 Office	1		
SPACES IN ZONE 7 (Zone 7)			
13. AHU 4-7 Offices	1		

AIR SYSTEM INPUT DATA

Name: AHU-5 DDC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
14. AHU 5 Acivity Room	1		

AIR SYSTEM INPUT DATA

Name: AHU-6 DDC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1
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1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
15. AHU 6 Travel / Kitchen	1		

PLANT NAME, CLASSIFICATION & TYPE

Plant name..................: Cooling Plant - Baseline
Classification..............: Cooling
Type........................: Air-Cooled Chiller
Type of simulation model....: Computer-Generated
Type of chiller.............: A/C Reciprocating

AIR SYSTEM SELECTIONS

Air System Name	Type	Quantity
1. AHU-1 Baseline	(SZ CAV)	1
2. AHU-2 Baseline	(MZ)	1
3. AHU-3 Baseline	(SZ CAV)	1
4. AHU-4 Baseline	(MZ)	1
5. AHU-5 Baseline	(SZ CAV)	1

AIR-COOLED RECIPROCATING CHILLER DATA

Estimated maximum cooling load...: NA
Chiller capacity at design.......: 112.0 Tons
Chiller input power at design....: 1.200 kW/Ton
Chiller configuration............: Mult. Compressors / Ckt., Unloaded
Is chilled water reset used......? N
Is hot gas bypass used...........? N
% load for minimum unloading.....: 20.0 %
Crankcase heater kW..............: 0.000 kW

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Efficiencies Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Chilled Water	10.0	54.00	80.0	89.0	3.84	5.0

PLANT INPUT DATA

Plant: Heating Plant - Baseline 12-30-94

Prepared By: EINHORN YAFFEE PRESCOTT Page 1

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PLANT NAME, CLASSIFICATION & TYPE

Plant name..................: Heating Plant - Baseline
Classification..............: Heating
Type........................: Hot Water Boiler

AIR SYSTEM SELECTIONS

Air System Name	Heating Coil Category Pre-Heat	Central	Terminal	Zone
1. AHU-1 Baseline..................	-	1	-	1
2. AHU-2 Baseline..................	-	1	-	-
3. AHU-3 Baseline..................	-	1	-	1
4. AHU-4 Baseline..................	-	1	-	-
5. AHU-5 Baseline..................	-	1	-	1
6. AHU-6 Baseline..................	-	1	-	1

HOT WATER BOILER DATA

Estimated maximum heating load...: 1425.6 MBH
Gross output at design...........: 1339.0 MBH
Energy input at design...........: 1575.0 MBH
Overall efficiency at design.....: 85.0 %
Fuel or energy type..............: Nat. Gas
Combustion air blower kW.........: 0.685 kW

BOILER PART-LOAD PERFORMANCE DATA

% Load	Overall Eff. (%)	% Load	Overall Eff. (%)
90	85.0	40	85.0
80	85.0	30	85.0
70	85.0	20	85.0
60	85.0	10	85.0
50	85.0	0	0.0

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Hot Water	20.0	48.00	75.0	89.0	1.81	5.0

it should be included as ... load ... in the input. Where should ...

C-80

PLANT NAME, CLASSIFICATION & TYPE

Plant name..................: Cooling Plant - PLC
Classification..............: Cooling
Type........................: Air-Cooled Chiller
Type of simulation model....: Computer-Generated
Type of chiller.............: A/C Reciprocating

AIR SYSTEM SELECTIONS

Air System Name	Type	Quantity
7. AHU-1 PLC......................	(SZ CAV)	1
8. AHU-2 PLC......................	(MZ)	1
9. AHU-3 PLC......................	(SZ CAV)	1
10. AHU-4 PLC......................	(MZ)	1
11. AHU-5 PLC......................	(SZ CAV)	1

AIR-COOLED RECIPROCATING CHILLER DATA

Estimated maximum cooling load...: NA
Chiller capacity at design.......: 112.0 Tons
Chiller input power at design....: 1.200 kW/Ton
Chiller configuration............: Mult. Compressors / Ckt., Unloaded
Is chilled water reset used......? N
Is hot gas bypass used...........? N
% load for minimum unloading.....: 20.0 %
Crankcase heater kW..............: 0.000 kW

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Efficiencies Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Chilled Water	10.0	54.00	80.0	89.0	3.84	5.0

PLANT INPUT DATA

Plant: Heating Plant - PLC 08-15-95

Prepared By: EINHORN YAFFEE PRESCOTT Page 1

PLANT NAME, CLASSIFICATION & TYPE

Plant name..................: Heating Plant - PLC

Classification..............: Heating

Type........................: Hot Water Boiler

AIR SYSTEM SELECTIONS

Air System Name	Heating Coil Category Pre-Heat	Central	Terminal	Zone
7. AHU-1 PLC	-	1	-	1
8. AHU-2 PLC	-	1	-	-
9. AHU-3 PLC	-	1	-	1
10. AHU-4 PLC	-	1	-	-
11. AHU-5 PLC	-	1	-	1
12. AHU-6 PLC	-	1	-	1

HOT WATER BOILER DATA

Estimated maximum heating load...: 1416.1 MBH

Gross output at design...........: 1339.0 MBH

Energy input at design...........: 1575.3 MBH

Overall efficiency at design.....: 85.0 %

Fuel or energy type..............: Nat. Gas

Combustion air blower kW.........: 0.685 kW

BOILER PART-LOAD PERFORMANCE DATA

% Load	Overall Eff. (%)	% Load	Overall Eff. (%)
90	85.0	40	85.0
80	85.0	30	85.0
70	85.0	20	85.0
60	85.0	10	85.0
50	85.0	0	0.0

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Hot Water	20.0	48.00	75.0	89.0	1.81	5.0

****

PLANT NAME, CLASSIFICATION & TYPE

Plant name..................:	Cooling Plant - DDC
Classification..............:	Cooling
Type........................:	Air-Cooled Chiller
Type of simulation model....:	Computer-Generated
Type of chiller.............:	A/C Reciprocating

AIR SYSTEM SELECTIONS

Air System Name	Type	Quantity
13. AHU-1 DDC......................	(SZ CAV)	1
14. AHU-2 DDC......................	(MZ)	1
15. AHU-3 DDC......................	(SZ CAV)	1
16. AHU-4 DDC......................	(MZ)	1
17. AHU-5 DDC......................	(SZ CAV)	1

AIR-COOLED RECIPROCATING CHILLER DATA

Estimated maximum cooling load...:	NA
Chiller capacity at design.......:	112.0 Tons
Chiller input power at design....:	1.200 kW/Ton
Chiller configuration............:	Mult. Compressors / Ckt., Unloaded
Is chilled water reset used......?	Y
Is hot gas bypass used...........?	N
% load for minimum unloading.....:	20.0 %
Crankcase heater kW..............:	0.000 kW

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Efficiencies Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Chilled Water	10.0	54.00	80.0	89.0	3.84	5.0

PLANT INPUT DATA

Plant: Heating Plant - DDC 08-15-95
Prepared By: EINHORN YAFFEE PRESCOTT Page 1

****

PLANT NAME, CLASSIFICATION & TYPE

Plant name..................: Heating Plant - DDC
Classification..............: Heating
Type........................: Hot Water Boiler

AIR SYSTEM SELECTIONS

	Heating Coil Category			
Air System Name	Pre-Heat	Central	Terminal	Zone
13. AHU-1 DDC......................	-	1	-	1
14. AHU-2 DDC......................	-	1	-	-
15. AHU-3 DDC......................	-	1	-	1
16. AHU-4 DDC......................	-	1	-	-
17. AHU-5 DDC......................	-	1	-	1
18. AHU-6 DDC......................	-	1	-	1

HOT WATER BOILER DATA

Estimated maximum heating load...: 1408.7 MBH
Gross output at design...........: 1339.0 MBH
Energy input at design...........: 1575.3 MBH
Overall efficiency at design.....: 85.0 %
Fuel or energy type..............: Nat. Gas
Combustion air blower kW.........: 0.685 kW

BOILER PART-LOAD PERFORMANCE DATA

% Load	Overall Eff. (%)	% Load	Overall Eff. (%)
90	85.0	40	85.0
80	85.0	30	85.0
70	85.0	20	85.0
60	85.0	10	85.0
50	85.0	0	0.0

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Efficiencies Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Hot Water	20.0	48.00	75.0	89.0	1.81	5.0

BUILDING INPUT DATA

Prepared by: EINHORN YAFFEE PRESCOTT 01-06-95

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****

BUILDING NAME..........: Building 200 - Baseline

PLANT SELECTION

	Plant Name	Type	Quantity
1.	Cooling Plant - Baseline.......	(A/C CHILLER)	1
2.	Heating Plant - Baseline.......	(HW BOILER)	1

MISCELLANEOUS ELECTRIC POWER USE

Reference Name	Max. Power Use (kW)	Schedule Name
Empty...	0.0	NA
Empty...	0.0	NA
Empty...	0.0	NA
Empty...	0.0	NA

MISCELLANEOUS FUEL USE

Reference Name	Fuel Type	Fuel Units	Conversion kBTU/Units	Max. Use	Schedule Name
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA

Fuel Types: NG=Nat.Gas FO=Fuel Oil PR=Propane RH=Rmt Htg

ELECTRIC RATE

Electric rate.................: Ft. Belvoir Equivalent $/kWh
Average building power factor.: NA

FUEL RATES

Natural gas...................: Washington Gas Rate Schedule 2
Fuel oil......................: None
Propane.......................: None
Remote source heating.........: Ft. Belvoir District Steam
Remote source cooling.........: None

MISCELLANEOUS DATA

Additional building floor area...................: 4854.0 sqft
Source electric generating efficiency............: 100.00 %

BUILDING NAME..........: Building 200 - PLC

PLANT SELECTION

	Plant Name	Type	Quantity
3.	Cooling Plant - PLC...........	(A/C CHILLER)	1
4.	Heating Plant - PLC...........	(HW BOILER)	1

MISCELLANEOUS ELECTRIC POWER USE

Reference Name	Max. Power Use (kW)	Schedule Name
Empty...	0.0	NA
Empty...	0.0	NA
Empty...	0.0	NA
Empty...	0.0	NA

MISCELLANEOUS FUEL USE

Reference Name	Fuel Type	Fuel Units	Conversion kBTU/Units	Max. Use	Schedule Name
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA

Fuel Types: NG=Nat.Gas FO=Fuel Oil PR=Propane RH=Rmt Htg

ELECTRIC RATE

Electric rate.................: Ft. Belvoir Equivalent $/kWh
Average building power factor.: NA

FUEL RATES

Natural gas..................: Washington Gas Rate Schedule 2
Fuel oil.....................: None
Propane......................: None
Remote source heating.........: Ft. Belvoir District Steam
Remote source cooling.........: None

MISCELLANEOUS DATA

Additional building floor area...................: 4854.0 sqft
Source electric generating efficiency............: 100.00 %

BUILDING INPUT DATA

Prepared by: EINHORN YAFFEE PRESCOTT 01-06-95

HAP v3.04

BUILDING NAME..........: Building 200 - DDC

PLANT SELECTION

Plant Name	Type	Quantity
5. Cooling Plant - DDC...........	(A/C CHILLER)	1
6. Heating Plant - DDC...........	(HW BOILER)	1

MISCELLANEOUS ELECTRIC POWER USE

Reference Name	Max. Power Use (kW)	Schedule Name
Empty...	0.0	NA
Empty...	0.0	NA
Empty...	0.0	NA
Empty...	0.0	NA

MISCELLANEOUS FUEL USE

Reference Name	Fuel Type	Fuel Units	Conversion kBTU/Units	Max. Use	Schedule Name
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA

Fuel Types: NG=Nat.Gas FO=Fuel Oil PR=Propane RH=Rmt Htg

ELECTRIC RATE

Electric rate.................: Ft. Belvoir Equivalent $/kWh
Average building power factor.: NA

FUEL RATES

Natural gas...................: Washington Gas Rate Schedule 2
Fuel oil......................: None
Propane.......................: None
Remote source heating.........: Ft. Belvoir District Steam
Remote source cooling.........: None

MISCELLANEOUS DATA

Additional building floor area...................: 4854.0 sqft
Source electric generating efficiency............: 100.00 %

BUILDING 219

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TABLE 1. SIMULATION WEATHER DATA DESIGN PARAMETERS

City...................................:	Washington
Location...............................:	Dist. of Columbia
Type of Data...........................:	Typical Meteorological Year
Latitude...............................:	38.9 deg
Longitude..............................:	77.0 deg
Elevation..............................:	14.0 ft
* Average Ground Reflectivity..............:	0.20
Local Time Zone (GMT +/- N hours).........:	5.0 hours
* Daylight Savings Time Considered.........?	N

* = User-defined design parameters. All other values are fixed.

TABLE 2. DRY-BULB TEMPERATURE STATISTICS (F)

Month	Absolute Maximum	Average Maximum	Average	Average Minimum	Absolute Minimum
January	60.4	39.3	30.7	21.0	-1.9
February	62.1	42.8	33.1	22.9	7.5
March	75.5	53.9	43.3	32.4	17.1
April	85.5	65.7	55.0	44.3	31.2
May	91.9	73.3	63.5	53.8	40.5
June	93.5	80.8	70.0	58.8	48.8
July	91.0	84.9	75.9	66.5	55.8
August	96.8	85.1	74.3	64.5	49.6
September	91.6	79.3	69.3	60.0	46.5
October	84.7	67.5	56.8	46.7	23.4
November	75.7	56.4	46.6	35.7	17.3
December	59.0	42.7	36.9	30.9	20.5

TABLE 3. DAILY TOTAL SOLAR RADIATION STATISTICS

	[---- Daily Total Solar ---] (BTU/sqft)			[-- Daily Clearness Number --] (Dimensionless)		
Month	Maximum	Average	Minimum	Maximum	Average	Minimum
January	1043.4	609.1	137.7	0.648	0.430	0.107
February	1448.6	815.5	79.9	0.685	0.433	0.048
March	1861.2	1183.4	211.6	0.680	0.473	0.094
April	2371.0	1484.8	247.6	0.717	0.479	0.079
May	2579.4	1712.0	355.4	0.711	0.487	0.104
June	2551.8	1890.8	515.8	0.697	0.514	0.140
July	2398.3	1714.6	629.5	0.657	0.478	0.171
August	2378.9	1696.2	708.2	0.694	0.522	0.227
September	1943.6	1307.6	258.0	0.674	0.482	0.094
October	1546.1	977.2	92.6	0.656	0.469	0.045
November	1143.4	672.4	129.4	0.647	0.437	0.094
December	803.2	488.0	73.1	0.618	0.382	0.057

Notes: * All solar data is daily total flux on a horizontal surface.
* Clearness number is (Daily Total Solar)/(Extraterrestrial Solar) Values between 0.70 and 0.80 represent clear conditions.

Calendar Name: Baseline	Day Type Assignments
January first is on: Saturday	Monday = Weekday Tuesday = Weekday Wednesday = Weekday
Day Type Names Day Type 1 = Weekday Day Type 2 = Saturday Day Type 3 = Sunday	Thursday = Weekday Friday = Weekday Saturday = Saturday Sunday = Sunday Holiday = Saturday

Holidays

January 1	January 17	February 21	May 30	July 4
September 5	November 24	November 25	December 26	

SCHEDULE DATA

Prepared By: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04

Schedule Name: People Hourly Percentages

Hour ----->	00	01	02	03	04	05	06	07	08	09	10	11
DESIGN DAY	0	0	0	0	0	0	0	0	50	100	100	100
Weekday	0	0	0	0	0	0	0	0	10	25	40	50
Saturday	0	0	0	0	0	0	0	0	0	0	0	0
Sunday	0	0	0	0	0	0	0	0	0	0	10	25

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
DESIGN DAY	100	100	100	100	100	100	100	100	100	75	50	0
Weekday	60	60	50	40	40	40	50	50	50	50	50	0
Saturday	10	50	50	50	50	50	50	50	50	50	50	0
Sunday	40	50	50	50	50	50	25	0	0	0	0	0

Schedule Name: Lights Hourly Percentages

Hour ----->	00	01	02	03	04	05	06	07	08	09	10	11
DESIGN DAY	25	25	25	25	25	25	25	50	75	100	100	100
Weekday	25	25	25	25	25	25	25	50	75	100	100	100
Saturday	25	25	25	25	25	25	25	25	25	25	25	25
Sunday	25	25	25	25	25	25	25	25	25	25	25	25

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
DESIGN DAY	100	100	100	100	100	50	25	25	25	25	25	25
Weekday	100	100	100	100	100	50	25	25	25	25	25	25
Saturday	25	25	25	25	25	25	25	25	25	25	25	25
Sunday	25	25	25	25	25	25	25	25	25	25	25	25

Schedule Name: People Auditorium Hourly Percentages

Hour ----->	00	01	02	03	04	05	06	07	08	09	10	11
DESIGN DAY	0	0	0	0	0	0	0	0	50	100	100	100
Weekday	0	0	0	0	0	0	0	0	10	25	25	25
Saturday	0	0	0	0	0	0	0	0	0	0	0	0
Sunday	0	0	0	0	0	0	0	0	0	0	10	25

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
DESIGN DAY	100	100	100	100	100	100	100	100	100	75	50	0
Weekday	25	25	25	25	25	25	25	25	25	50	50	50
Saturday	10	50	50	50	50	50	50	50	50	50	50	0
Sunday	40	50	50	50	50	50	25	0	0	0	0	0

SCHEDULE DATA

Prepared By: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04

Schedule Name: Lights - Auditorium Hourly Percentages

Hour ----->	00	01	02	03	04	05	06	07	08	09	10	11
DESIGN DAY	15	15	15	15	15	15	15	15	50	100	100	100
Weekday	15	15	15	15	15	15	15	15	10	100	100	100
Saturday	15	15	15	15	15	15	15	15	15	15	15	15
Sunday	15	15	15	15	15	15	15	15	15	15	15	100

Hour ----->	12	13	14	15	16	17	18	19	20	21	22	23
DESIGN DAY	100	100	100	100	100	100	100	100	100	75	50	15
Weekday	100	100	100	100	100	100	100	100	100	50	50	50
Saturday	15	100	100	100	100	100	100	100	100	100	100	15
Sunday	100	100	100	100	100	100	25	15	15	15	15	15

WALL CONSTRUCTION TYPES

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

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****

WALL TYPE 1: (CUSTOM WALL)

Description...........: Brick Cavity Wall

Absorptivity..........: 0.900

Layer Description	Thickness	Density	Spec.Ht	R-Val	Weight
Inside surface resistance	-	-	-	0.69	-
1/2-in (13 mm) gypsum plaster	0.50	45.0	0.32	0.32	1.9
8-in (203 mm) LW concrete block	8.00	38.0	0.20	2.02	25.3
4-in (102 mm) face brick	4.00	125.0	0.22	0.43	41.7
Outside surface resistance	-	-	-	0.33	-
Totals	12.50			3.79	68.9

Thickness: in Density: lb/cuft Weight: lb/sqft

R-value : (hr-sqft-F)/BTU Specific Heat: BTU/lb/F

****

ROOF TYPE 1: (CUSTOM ROOF)

Description...........: Shingle Roof
Absorptivity..........: 0.900

Layer Description	Thickness	Density	Spec.Ht	R-Val	Weight
Inside surface resistance	-	-	-	0.69	-
3/4" Acoustic Ceiling Tile	0.75	18.0	0.14	1.89	1.1
1/2-in (13 mm) plywood	0.50	34.0	0.29	0.62	1.4
Asphalt shingles	0.13	70.0	0.30	0.43	0.7
Outside surface resistance	-	-	-	0.33	-
Totals	1.38			3.96	3.3

Thickness: in Density: lb/cuft Weight: lb/sqft
R-value : (hr-sqft-F)/BTU Specific Heat: BTU/lb/F

****

WINDOW TYPE 1: (SIMPLE WINDOW)

Window Description.....: Single Pane (By sqft)
Height.................: 1.00 ft
Width..................: 1.00 ft
Overall U-value........: 1.110 BTU/hr/sqft/F
Overall Shade Coeff....: 0.870

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

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****

GENERAL
Name......: East Perimeter - 1st Flr
Floor Area......: 1550.0 sqft
Building Weight.: 70.0 lb/sqft
Windows Shaded..? N
Partitions Used.? N

LIGHTING
Overhead Fixture: Recessed
Lamp Wattage....: 3.00 W/sqft
Ballast Mult....: 1.00
Task Lighting...: 0.00 W/sqft

PEOPLE
Occupancy.......: 200.0 sqft/per
Activity Level..: Office Work
Sensible........: 245.0 BTU/hr
Latent..........: 205.0 BTU/hr

OTHER LOADS
Equipment.......: 1.50 W/sqft
Misc. Sensible..: 0.0 BTU/hr
Misc. Latent....: 0.0 BTU/hr

SCHEDULES
Lighting....: Lights
Task Lights.: Lights
People......: People
Equipment...: People
Misc. Sens..: People
Misc. Latent: People

INFILTRATION
Cooling.....: 0.00 CFM/sqft
Heating.....: 0.00 CFM/sqft
Typical.....: 0.10 CFM/sqft
When Fan On.? Y

FLOOR
Type........:Above Conditioned Space

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
E	1290.0	1	1	810	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	984.0	1	1	0

No partition data for this space.

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SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04

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```
GENERAL                                    SCHEDULES
 Name......: South Perimeter - 1st Fl       Lighting....: Lights
 Floor Area......:     850.0 sqft           Task Lights.: Lights
 Building Weight.:      70.0 lb/sqft        People......: People
 Windows Shaded..?         N                Equipment...: People
 Partitions Used.?         N                Misc. Sens..: People
LIGHTING                                    Misc. Latent: People
 Overhead Fixture: Recessed                INFILTRATION
 Lamp Wattage....:      3.00 W/sqft         Cooling.....:      0.00 CFM/sqft
 Ballast Mult....:      1.00                Heating.....:      0.00 CFM/sqft
 Task Lighting...:      0.00 W/sqft         Typical.....:      0.10 CFM/sqft
PEOPLE                                      When Fan On.?         Y
 Occupancy.......:     200.0 sqft/per      FLOOR
 Activity Level..: Office Work              Type........:Above Conditioned Space
 Sensible........:     245.0 BTU/hr
 Latent..........:     205.0 BTU/hr
OTHER LOADS
 Equipment.......:      1.50 W/sqft
 Misc. Sensible..:       0.0 BTU/hr
 Misc. Latent....:       0.0 BTU/hr
```

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
S	480.0	1	1	216	-	1	0	-	N
N	430.0	1	1	0	-	1	0	-	N

No roof or door data for this space.

No partition data for this space.

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****

GENERAL
Name......: West Perimeter - 1st Flr
Floor Area......: 1350.0 sqft
Building Weight.: 70.0 lb/sqft
Windows Shaded..? N
Partitions Used.? N

LIGHTING
Overhead Fixture: Recessed
Lamp Wattage....: 3.00 W/sqft
Ballast Mult....: 1.00
Task Lighting...: 0.00 W/sqft

PEOPLE
Occupancy.......: 200.0 sqft/per
Activity Level..: Office Work
Sensible........: 245.0 BTU/hr
Latent..........: 205.0 BTU/hr

OTHER LOADS
Equipment.......: 1.50 W/sqft
Misc. Sensible..: 0.0 BTU/hr
Misc. Latent....: 0.0 BTU/hr

SCHEDULES
Lighting....: Lights
Task Lights.: Lights
People......: People
Equipment...: People
Misc. Sens..: People
Misc. Latent: People

INFILTRATION
Cooling.....: 0.00 CFM/sqft
Heating.....: 0.00 CFM/sqft
Typical.....: 0.10 CFM/sqft
When Fan On.? Y

FLOOR
Type........:Above Conditioned Space

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
W	1530.0	1	1	144	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	664.0	1	1	0

No partition data for this space.

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04 Page 1

****

GENERAL
 Name......: North Perimeter - 1st Fl
 Floor Area......: 132.0 sqft
 Building Weight.: 70.0 lb/sqft
 Windows Shaded..? N
 Partitions Used.? N

LIGHTING
 Overhead Fixture: Recessed
 Lamp Wattage....: 3.00 W/sqft
 Ballast Mult....: 1.00
 Task Lighting...: 0.00 W/sqft

PEOPLE
 Occupancy.......: 200.0 sqft/per
 Activity Level..: Office Work
 Sensible........: 245.0 BTU/hr
 Latent..........: 205.0 BTU/hr

OTHER LOADS
 Equipment.......: 1.50 W/sqft
 Misc. Sensible..: 0.0 BTU/hr
 Misc. Latent....: 0.0 BTU/hr

SCHEDULES
 Lighting....: Lights
 Task Lights.: Lights
 People......: People
 Equipment...: People
 Misc. Sens..: People
 Misc. Latent: People

INFILTRATION
 Cooling.....: 0.00 CFM/sqft
 Heating.....: 0.00 CFM/sqft
 Typical.....: 0.10 CFM/sqft
 When Fan On.? Y

FLOOR
 Type........:Above Conditioned Space

===

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
N	110.0	1	1	0	-	1	0	-	N

===

No roof or door data for this space.

===

No partition data for this space.

===

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04

****

GENERAL
- Name......: Interior - 1st Flr
- Floor Area......: 10861.0 sqft
- Building Weight.: 70.0 lb/sqft
- Windows Shaded..? N
- Partitions Used.? N

LIGHTING
- Overhead Fixture: Recessed
- Lamp Wattage....: 3.00 W/sqft
- Ballast Mult....: 1.00
- Task Lighting...: 0.00 W/sqft

PEOPLE
- Occupancy.......: 200.0 sqft/per
- Activity Level..: Office Work
- Sensible........: 245.0 BTU/hr
- Latent..........: 205.0 BTU/hr

OTHER LOADS
- Equipment.......: 1.50 W/sqft
- Misc. Sensible..: 0.0 BTU/hr
- Misc. Latent....: 0.0 BTU/hr

SCHEDULES
- Lighting....: Lights
- Task Lights.: Lights
- People......: People
- Equipment...: People
- Misc. Sens..: People
- Misc. Latent: People

INFILTRATION
- Cooling.....: 0.00 CFM/sqft
- Heating.....: 0.00 CFM/sqft
- Typical.....: 0.00 CFM/sqft
- When Fan On.? N

FLOOR
- Type........:Above Conditioned Space

==

No external wall or window data for this space.

==

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	2520.0	1	1	0

==

No partition data for this space.

==

C-100

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04

GENERAL
- Name......: East Perimeter - 2nd Flr
- Floor Area......: 1530.0 sqft
- Building Weight.: 70.0 lb/sqft
- Windows Shaded..? N
- Partitions Used.? N

LIGHTING
- Overhead Fixture: Recessed
- Lamp Wattage....: 3.00 W/sqft
- Ballast Mult....: 1.00
- Task Lighting...: 0.00 W/sqft

PEOPLE
- Occupancy.......: 200.0 sqft/per
- Activity Level..: Office Work
- Sensible........: 245.0 BTU/hr
- Latent..........: 205.0 BTU/hr

OTHER LOADS
- Equipment.......: 1.50 W/sqft
- Misc. Sensible..: 0.0 BTU/hr
- Misc. Latent....: 0.0 BTU/hr

SCHEDULES
- Lighting....: Lights
- Task Lights.: Lights
- People......: People
- Equipment...: People
- Misc. Sens..: People
- Misc. Latent: People

INFILTRATION
- Cooling.....: 0.00 CFM/sqft
- Heating.....: 0.00 CFM/sqft
- Typical.....: 0.10 CFM/sqft
- When Fan On.? Y

FLOOR
- Type........:Above Conditioned Space

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
E	1490.0	1	1	232	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	1530.0	1	1	0

No partition data for this space.

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04 Page 1

GENERAL
- Name......: South Perimeter - 2nd Fl
- Floor Area......: 1200.0 sqft
- Building Weight.: 70.0 lb/sqft
- Windows Shaded..? N
- Partitions Used.? N

LIGHTING
- Overhead Fixture: Recessed
- Lamp Wattage....: 3.00 W/sqft
- Ballast Mult....: 1.00
- Task Lighting...: 0.00 W/sqft

PEOPLE
- Occupancy.......: 200.0 sqft/per
- Activity Level..: Office Work
- Sensible........: 245.0 BTU/hr
- Latent..........: 205.0 BTU/hr

OTHER LOADS
- Equipment.......: 1.50 W/sqft
- Misc. Sensible..: 0.0 BTU/hr
- Misc. Latent....: 0.0 BTU/hr

SCHEDULES
- Lighting....: Lights
- Task Lights.: Lights
- People......: People
- Equipment...: People
- Misc. Sens..: People
- Misc. Latent: People

INFILTRATION
- Cooling.....: 0.00 CFM/sqft
- Heating.....: 0.00 CFM/sqft
- Typical.....: 0.10 CFM/sqft
- When Fan On.? Y

FLOOR
- Type........:Above Conditioned Space

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
S	1120.0	1	1	288	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	1200.0	1	1	0

No partition data for this space.

C-102

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04 Page 1

****

GENERAL

Name......: West Perimeter - 2nd Flr

Floor Area......: 1632.0 sqft

Building Weight.: 70.0 lb/sqft

Windows Shaded..? N

Partitions Used.? N

LIGHTING

Overhead Fixture: Recessed

Lamp Wattage....: 3.00 W/sqft

Ballast Mult....: 1.00

Task Lighting...: 0.00 W/sqft

PEOPLE

Occupancy.......: 200.0 sqft/per

Activity Level..: Office Work

Sensible........: 245.0 BTU/hr

Latent..........: 205.0 BTU/hr

OTHER LOADS

Equipment.......: 1.50 W/sqft

Misc. Sensible..: 0.0 BTU/hr

Misc. Latent....: 0.0 BTU/hr

SCHEDULES

Lighting....: Lights

Task Lights.: Lights

People......: People

Equipment...: People

Misc. Sens..: People

Misc. Latent: People

INFILTRATION

Cooling.....: 0.00 CFM/sqft

Heating.....: 0.00 CFM/sqft

Typical.....: 0.10 CFM/sqft

When Fan On.? Y

FLOOR

Type........:Above Conditioned Space

==

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
W	1600.0	1	1	162	-	1	0	-	N

==

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	1632.0	1	1	0

==

No partition data for this space.

==

C-103

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04 Page 1

```
**************************************************************************
GENERAL                                  SCHEDULES
 Name......: North Perimeter - 2nd Fl     Lighting....: Lights
 Floor Area......:      792.0 sqft        Task Lights.: Lights
 Building Weight.:       70.0 lb/sqft     People......: People
 Windows Shaded..?          N             Equipment...: People
 Partitions Used.?          N             Misc. Sens..: People
LIGHTING                                  Misc. Latent: People
 Overhead Fixture: Recessed              INFILTRATION
 Lamp Wattage....:       3.00 W/sqft      Cooling.....:      0.00 CFM/sqft
 Ballast Mult....:       1.00             Heating.....:      0.00 CFM/sqft
 Task Lighting...:       0.00 W/sqft      Typical.....:      0.10 CFM/sqft
PEOPLE                                    When Fan On.?         Y
 Occupancy.......:      200.0 sqft/per FLOOR
 Activity Level..: Office Work            Type........:Above Conditioned Space
 Sensible........:      245.0 BTU/hr
 Latent..........:      205.0 BTU/hr
OTHER LOADS
 Equipment.......:       1.50 W/sqft
 Misc. Sensible..:        0.0 BTU/hr
 Misc. Latent....:        0.0 BTU/hr
==========================================================================
WALL  Gross Area  |  WALL  |      WINDOW       |       WINDOW      |  Any
Exp       (sqft)  |  Type  | Type  Qty  Shade  | Type  Qty  Shade  | Doors?
--------------------------------------------------------------------------
N         800.0   |     1  |   1     0      -  |   1     0      -  |   N
==========================================================================
ROOF  Slope    Gross Area  | ROOF | SKYLIGHT  |
Exp   (deg)        (sqft)  | Type |Type   Qty |
--------------------------------------------|
HOR     -           792.0  |    1 |  1     0  |
==========================================================================
No partition data for this space.
==========================================================================
```

C-104

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04 Page 1

****

GENERAL		**SCHEDULES**	
Name......:	Interior - 2nd Flr	Lighting....:	Lights
Floor Area......:	5040.0 sqft	Task Lights.:	Lights
Building Weight.:	70.0 lb/sqft	People......:	People
Windows Shaded..?	N	Equipment...:	People
Partitions Used.?	N	Misc. Sens..:	People
LIGHTING		Misc. Latent:	People
Overhead Fixture:	Recessed	**INFILTRATION**	
Lamp Wattage....:	3.00 W/sqft	Cooling.....:	0.00 CFM/sqft
Ballast Mult....:	1.00	Heating.....:	0.00 CFM/sqft
Task Lighting...:	0.00 W/sqft	Typical.....:	0.00 CFM/sqft
PEOPLE		When Fan On.?	N
Occupancy.......:	200.0 sqft/per	**FLOOR**	
Activity Level..:	Office Work	Type........:	Above Conditioned Space
Sensible........:	245.0 BTU/hr		
Latent..........:	205.0 BTU/hr		
OTHER LOADS			
Equipment.......:	1.50 W/sqft		
Misc. Sensible..:	0.0 BTU/hr		
Misc. Latent....:	0.0 BTU/hr		

==

No external wall or window data for this space.

==

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	5040.0	1	1	0

==

No partition data for this space.

==

C-105

SPACE DESCRIPTION

Prepared by: EINHORN YAFFEE PRESCOTT 12-30-94

HAP v3.04 Page 1

****

GENERAL
- Name......: Auditorium
- Floor Area......: 8000.0 sqft
- Building Weight.: 70.0 lb/sqft
- Windows Shaded..? N
- Partitions Used.? N

LIGHTING
- Overhead Fixture: Recessed
- Lamp Wattage....: 3.00 W/sqft
- Ballast Mult....: 1.00
- Task Lighting...: 0.00 W/sqft

PEOPLE
- Occupancy.......: 15.0 sqft/per
- Activity Level..: Seated at Rest
- Sensible........: 230.0 BTU/hr
- Latent..........: 120.0 BTU/hr

OTHER LOADS
- Equipment.......: 0.00 W/sqft
- Misc. Sensible..: 0.0 BTU/hr
- Misc. Latent....: 0.0 BTU/hr

SCHEDULES
- Lighting....: Lights - Auditorium
- Task Lights.: Lights - Auditorium
- People......: People Auditorium
- Equipment...: People Auditorium
- Misc. Sens..: People Auditorium
- Misc. Latent: People Auditorium

INFILTRATION
- Cooling.....: 0.00 CFM/sqft
- Heating.....: 0.00 CFM/sqft
- Typical.....: 0.10 CFM/sqft
- When Fan On.? Y

FLOOR
- Type........:Slab On Grade
- Perimeter.............: 300.0 ft
- Slab Floor Area.......: 8000.0 sqft
- Floor R-Value.........: 2.40
- Insulation R-value....: 0.00

WALL Exp	Gross Area (sqft)	WALL Type	WINDOW Type	WINDOW Qty	WINDOW Shade	WINDOW Type	WINDOW Qty	WINDOW Shade	Any Doors?
N	2460.0	1	1	0	-	1	0	-	N
E	1300.0	1	1	0	-	1	0	-	N
S	1230.0	1	1	0	-	1	0	-	N
W	1300.0	1	1	0	-	1	0	-	N

ROOF Exp	Slope (deg)	Gross Area (sqft)	ROOF Type	SKYLIGHT Type	SKYLIGHT Qty
HOR	-	8000.0	1	1	0

No partition data for this space.

C-106

AIR SYSTEM INPUT DATA

Name: Fan Coil Units - Baseline 12-30-94
Type: TERMINAL UNITS - 2-Pipe Fan Coils HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SYSTEM NAME AND TYPE

```
------------------------------------------------------------------------
  Name............: Fan Coil Units - Baseline
  Type............: TERMINAL UNITS  - 2-Pipe Fan Coils
  Number of Zones.:  8
========================================================================
```

2. SYSTEM DESCRIPTION

```
------------------------------------------------------------------------
COOLING SYSTEM DATA
 Supply Air....................:           55.0 F
 Fan Cycled for Cooling........?             N
 Coil Bypass Factor............:          0.100
HEATING SYSTEM DATA
 Fan Cycled for Heating........?             N
OUTDOOR VENTILATION DATA
 Common Ventilation System Used?             N
SAFETY FACTORS
 Sensible Cooling Factor.......:             0 %
 Latent Cooling Factor.........:             0 %
 Heating Factor................:             0 %
OUTDOOR VENTILATION DATA
 Type of Control...............:    Constant Airflow Rate
 Design Ventilation Airflow....:           0.0 CFM/person
========================================================================
```

3. ZONE DATA

```
------------------------------------------------------------------------
ZONE                                     1  (All Zones the Same)
T-Stat Occupied Cooling....(F):       75.0
       Unoccupied Cooling..(F):       85.0
       Occupied Heating....(F):       70.0
       Unoccupied Heating..(F):       55.0
       Throttling Range....(F):        3.0
Zone Terminal Type............:   Fan Coil
  Fan Total Static....(in.wg.):       0.25
  Fan Efficiency..........(%):          54
========================================================================
```

****

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Weekday...............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Saturday..............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sunday................	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Cooling Available During Unoccupied Period ? Y

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Terminal Heating.......	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Terminal Cooling.......					XXX	XXX	XXX	XXX	XXX			

AIR SYSTEM INPUT DATA

1. SYSTEM NAME AND TYPE

Name............: Interior 219 - Baseline
Type............: CONSTANT VOLUME - Single Zone CAV
Number of Zones.: 1

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA	
Is Central Cooling Used.......?	Y
Supply Air....................:	12930.0 CFM
Coil Bypass Factor............:	0.100
Fan Cycled for Cooling........?	N
Supply Air Reset..............:	Not Used
HEATING SYSTEM DATA	
Is Central Heating Used.......?	Y
Fan Cycled for Heating........?	N
Supply Air Reset..............:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control...............:	Constant Airflow Rate
Design Ventilation Airflow....:	3230.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate..............:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain................:	2 %
Duct Leakage Rate.............:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used.......?	N
SUPPLY FAN DATA	
Fan Type......................:	Forward Curved
Configuration.................:	Draw-Thru
Fan Total Static..............:	2.00 in.wg.
Fan Efficiency................:	54 %
RETURN FAN DATA	
Fan Type......................:	User Defined
Fan Total Static..............:	0.25 in.wg.
Fan Efficiency................:	50 %
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type.......:	None
PREHEAT COIL	
Preheat Coil Used.............?	N
PRECOOL COIL	
Precool Coil Used.............?	N
HUMIDIFICATION	
Humidification System Used....?	N
DEHUMIDIFICATION	
Dehumidification System Used..?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type.............:	None
SAFETY FACTORS	
Sensible Cooling Factor.......:	0 %
Latent Cooling Factor.........:	0 %
Heating Factor................:	0 %

AIR SYSTEM INPUT DATA

Name: Interior 219 - Baseline 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 2

****

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	None	
Trip Temperature.........(F):	-	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	0.0	
Direct Exhaust Fan kW.....(kW):	0.0	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Weekday................	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Saturday...............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sunday.................	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Cooling Available During Unoccupied Period ? Y

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Central Heating........	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Central Cooling........					XXX	XXX	XXX	XXX	XXX			

AIR SYSTEM INPUT DATA

****

1. SYSTEM NAME AND TYPE

Name............:	Auditorium - Baseline
Type............:	CONSTANT VOLUME - Single Zone CAV
Number of Zones.:	1

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA	
Is Central Cooling Used.......?	Y
Supply Air....................:	30000.0 CFM
Coil Bypass Factor............:	0.100
Fan Cycled for Cooling........?	N
Supply Air Reset..............:	Not Used
HEATING SYSTEM DATA	
Is Central Heating Used.......?	Y
Fan Cycled for Heating........?	N
Supply Air Reset..............:	Not Used
OUTDOOR VENTILATION DATA	
Type of Control...............:	Constant Airflow Rate
Design Ventilation Airflow....:	5000.0 CFM
Dampers Open During Unocc Per.:	N
Damper Leak Rate..............:	2 %
SUPPLY DUCT DATA	
Duct Heat Gain................:	2 %
Duct Leakage Rate.............:	5 %
RETURN PLENUM DATA	
Is a Return Plenum Used.......?	N
SUPPLY FAN DATA	
Fan Type......................:	Forward Curved
Configuration.................:	Draw-Thru
Fan Total Static..............:	2.50 in.wg.
Fan Efficiency................:	54 %
RETURN FAN DATA	
Fan Type......................:	None
OUTDOOR AIR ECONOMIZER	
Outdoor Economizer Type.......:	None
PREHEAT COIL	
Preheat Coil Used.............?	N
PRECOOL COIL	
Precool Coil Used.............?	N
HUMIDIFICATION	
Humidification System Used....?	N
DEHUMIDIFICATION	
Dehumidification System Used..?	N
VENTILATION HEAT RECLAIM	
Reclaim Unit Type.............:	None
SAFETY FACTORS	
Sensible Cooling Factor.......:	0 %
Latent Cooling Factor.........:	0 %
Heating Factor................:	0 %

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	None	
Trip Temperature.........(F):	-	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	0.0	
Direct Exhaust Fan kW.....(kW):	0.0	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Weekday................	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Saturday...............	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sunday.................	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Cooling Available During Unoccupied Period ? Y

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Central Heating........	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Central Cooling........					XXX	XXX	XXX	XXX	XXX			

AIR SYSTEM INPUT DATA

1. SYSTEM NAME AND TYPE

Name............: Fan Coil Units - PLC
Type............: TERMINAL UNITS - 2-Pipe Fan Coils
Number of Zones.: 8

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA	
Supply Air....................:	55.0 F
Fan Cycled for Cooling........?	N
Coil Bypass Factor............:	0.100
HEATING SYSTEM DATA	
Fan Cycled for Heating........?	N
OUTDOOR VENTILATION DATA	
Common Ventilation System Used?	N
SAFETY FACTORS	
Sensible Cooling Factor.......:	0 %
Latent Cooling Factor.........:	0 %
Heating Factor................:	0 %
OUTDOOR VENTILATION DATA	
Type of Control...............:	Constant Airflow Rate
Design Ventilation Airflow....:	0.0 CFM/person

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Terminal Type............:	Fan Coil	
Fan Total Static....(in.wg.):	0.25	
Fan Efficiency...........(%):	54	

AIR SYSTEM INPUT DATA

Name: Fan Coil Units - PLC 12-30-94
Type: TERMINAL UNITS - 2-Pipe Fan Coils HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT

****

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............								X	X	X	X	X	X	X	X	X	X	X	X					
Weekday................								X	X	X	X	X	X	X	X	X	X	X	X					
Saturday...............																								
Sunday.................																								

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Terminal Heating.......	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Terminal Cooling.......					XXX	XXX	XXX	XXX	XXX			

AIR SYSTEM INPUT DATA

Name: Interior 219 - PLC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SYSTEM NAME AND TYPE

Name............: Interior 219 - PLC
Type............: CONSTANT VOLUME - Single Zone CAV
Number of Zones.: 1

==

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA
Is Central Cooling Used.......? Y
Supply Air....................: 12930.0 CFM
Coil Bypass Factor............: 0.100
Fan Cycled for Cooling........? N
Supply Air Reset..............: Not Used
HEATING SYSTEM DATA
Is Central Heating Used.......? Y
Fan Cycled for Heating........? N
Supply Air Reset..............: Not Used
OUTDOOR VENTILATION DATA
Type of Control...............: Constant Airflow Rate
Design Ventilation Airflow....: 3230.0 CFM
Dampers Open During Unocc Per.: N
Damper Leak Rate..............: 2 %
SUPPLY DUCT DATA
Duct Heat Gain................: 2 %
Duct Leakage Rate.............: 5 %
RETURN PLENUM DATA
Is a Return Plenum Used.......? N
SUPPLY FAN DATA
Fan Type......................: Forward Curved
Configuration.................: Draw-Thru
Fan Total Static..............: 2.00 in.wg.
Fan Efficiency................: 54 %
RETURN FAN DATA
Fan Type......................: User Defined
Fan Total Static..............: 0.25 in.wg.
Fan Efficiency................: 50 %
OUTDOOR AIR ECONOMIZER
Outdoor Economizer Type.......: None
PREHEAT COIL
Preheat Coil Used.............? N
PRECOOL COIL
Precool Coil Used.............? N
HUMIDIFICATION
Humidification System Used....? N
DEHUMIDIFICATION
Dehumidification System Used..? N
VENTILATION HEAT RECLAIM
Reclaim Unit Type.............: None
SAFETY FACTORS
Sensible Cooling Factor.......: 0 %
Latent Cooling Factor.........: 0 %
Heating Factor................: 0 %

==

AIR SYSTEM INPUT DATA

Name: Interior 219 - PLC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 2

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	None	
Trip Temperature.........(F):	-	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	0.0	
Direct Exhaust Fan kW.....(kW):	0.0	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............								X	X	X	X	X	X	X	X	X	X	X	X					
Weekday................								X	X	X	X	X	X	X	X	X	X	X	X					
Saturday...............																								
Sunday.................																								

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Central Heating........	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Central Cooling........					XXX	XXX	XXX	XXX	XXX			

AIR SYSTEM INPUT DATA

Name: Auditorium - PLC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SYSTEM NAME AND TYPE

Name............: Auditorium - PLC
Type............: CONSTANT VOLUME - Single Zone CAV
Number of Zones.: 1

==

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA
- Is Central Cooling Used.......? Y
- Supply Air....................: 30000.0 CFM
- Coil Bypass Factor............: 0.100
- Fan Cycled for Cooling........? N
- Supply Air Reset..............: Not Used

HEATING SYSTEM DATA
- Is Central Heating Used.......? Y
- Fan Cycled for Heating........? N
- Supply Air Reset..............: Not Used

OUTDOOR VENTILATION DATA
- Type of Control...............: Constant Airflow Rate
- Design Ventilation Airflow....: 5000.0 CFM
- Dampers Open During Unocc Per.: N
- Damper Leak Rate..............: 2 %

SUPPLY DUCT DATA
- Duct Heat Gain................: 2 %
- Duct Leakage Rate.............: 5 %

RETURN PLENUM DATA
- Is a Return Plenum Used.......? N

SUPPLY FAN DATA
- Fan Type......................: Forward Curved
- Configuration.................: Draw-Thru
- Fan Total Static..............: 0.90 in.wg.
- Fan Efficiency................: 54 %

RETURN FAN DATA
- Fan Type......................: None

OUTDOOR AIR ECONOMIZER
- Outdoor Economizer Type.......: None

PREHEAT COIL
- Preheat Coil Used.............? N

PRECOOL COIL
- Precool Coil Used.............? N

HUMIDIFICATION
- Humidification System Used....? N

DEHUMIDIFICATION
- Dehumidification System Used..? N

VENTILATION HEAT RECLAIM
- Reclaim Unit Type.............: None

SAFETY FACTORS
- Sensible Cooling Factor.......: 0 %
- Latent Cooling Factor.........: 0 %
- Heating Factor................: 0 %

==

AIR SYSTEM INPUT DATA

Name: Auditorium - PLC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 2

****

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	None	
Trip Temperature.........(F):	-	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency..........(%):	-	
Zone Terminal Type............:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	0.0	
Direct Exhaust Fan kW.....(kW):	0.0	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day............								X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Weekday...............								X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Saturday..............								X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Sunday................								X	X	X	X	X	X	X	X	X	X	X	X	X	X			

Cooling Available During Unoccupied Period ? Y

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Central Heating........	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Central Cooling........					XXX	XXX	XXX	XXX	XXX			

****

1. SYSTEM NAME AND TYPE

Name............: Fan Coil Units - DDC
Type............: TERMINAL UNITS - 2-Pipe Fan Coils
Number of Zones.: 8

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA	
Supply Air....................:	55.0 F
Fan Cycled for Cooling........?	N
Coil Bypass Factor............:	0.100
HEATING SYSTEM DATA	
Fan Cycled for Heating........?	N
OUTDOOR VENTILATION DATA	
Common Ventilation System Used?	N
SAFETY FACTORS	
Sensible Cooling Factor.......:	0 %
Latent Cooling Factor.........:	0 %
Heating Factor................:	0 %
OUTDOOR VENTILATION DATA	
Type of Control...............:	Constant Airflow Rate
Design Ventilation Airflow....:	0.0 CFM/person

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Terminal Type............:	Fan Coil	
Fan Total Static....(in.wg.):	0.25	
Fan Efficiency...........(%):	54	

AIR SYSTEM INPUT DATA

Name: Fan Coil Units - DDC 12-30-94
Type: TERMINAL UNITS - 2-Pipe Fan Coils HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 2

****

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day.............								X	X	X	X	X	X	X	X	X	X	X	X					
Weekday................								X	X	X	X	X	X	X	X	X	X	X	X					
Saturday...............																								
Sunday.................																								

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Terminal Heating.......	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Terminal Cooling.......					XXX	XXX	XXX	XXX	XXX			

AIR SYSTEM INPUT DATA

Name: Interior 219 - DDC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SYSTEM NAME AND TYPE

```
  Name............: Interior 219 - DDC
  Type............: CONSTANT VOLUME - Single Zone CAV
  Number of Zones.:  1
```

2. SYSTEM DESCRIPTION

```
COOLING SYSTEM DATA
 Is Central Cooling Used.......?            Y
 Supply Air....................:      12930.0 CFM
 Coil Bypass Factor............:        0.100
 Fan Cycled for Cooling........?            N
 Supply Air Reset..............:    Not Used
HEATING SYSTEM DATA
 Is Central Heating Used.......?            Y
 Fan Cycled for Heating........?            N
 Supply Air Reset..............:    Not Used
OUTDOOR VENTILATION DATA
 Type of Control...............:    Constant Airflow Rate
 Design Ventilation Airflow....:       3230.0 CFM
 Dampers Open During Unocc Per.:            N
 Damper Leak Rate..............:            2 %
SUPPLY DUCT DATA
 Duct Heat Gain................:            2 %
 Duct Leakage Rate.............:            5 %
RETURN PLENUM DATA
 Is a Return Plenum Used.......?            N
SUPPLY FAN DATA
 Fan Type......................:    Forward Curved
 Configuration.................:    Draw-Thru
 Fan Total Static..............:         2.00 in.wg.
 Fan Efficiency................:           54 %
RETURN FAN DATA
 Fan Type......................:    User Defined
 Fan Total Static..............:         0.25 in.wg.
 Fan Efficiency................:           50 %
OUTDOOR AIR ECONOMIZER
 Outdoor Economizer Type.......:    Integrated Enthalpy
 OA Upper Cutoff Temp..........:         95.0 F
 OA Lower Cutoff Temp..........:          0.0 F
PREHEAT COIL
 Preheat Coil Used.............?            N
PRECOOL COIL
 Precool Coil Used.............?            N
HUMIDIFICATION
 Humidification System Used....?            N
DEHUMIDIFICATION
 Dehumidification System Used..?            N
VENTILATION HEAT RECLAIM
 Reclaim Unit Type.............:    None
```

Name: Interior 219 - DDC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT

****

2. SYSTEM DESCRIPTION (CONTINUED)

SAFETY FACTORS

Sensible Cooling Factor.......:	0 %
Latent Cooling Factor.........:	0 %
Heating Factor................:	0 %

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	None	
Trip Temperature.........(F):	-	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	0.0	
Direct Exhaust Fan kW.....(kW):	0.0	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day............								X	X	X	X	X	X	X	X	X	X	X	X					
Weekday................								X	X	X	X	X	X	X	X	X	X	X	X					
Saturday...............																								
Sunday.................																								

Cooling Available During Unoccupied Period ? N

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Central Heating........	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Central Cooling........					XXX	XXX	XXX	XXX	XXX			

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AIR SYSTEM INPUT DATA

****

1. SYSTEM NAME AND TYPE

Name............: Auditorium - DDC
Type............: CONSTANT VOLUME - Single Zone CAV
Number of Zones.: 1

==

2. SYSTEM DESCRIPTION

COOLING SYSTEM DATA
Is Central Cooling Used.......? Y
Supply Air....................: 30000.0 CFM
Coil Bypass Factor............: 0.100
Fan Cycled for Cooling........? N
Supply Air Reset..............: Not Used
HEATING SYSTEM DATA
Is Central Heating Used.......? Y
Fan Cycled for Heating........? N
Supply Air Reset..............: Not Used
OUTDOOR VENTILATION DATA
Type of Control...............: Constant Airflow Rate
Design Ventilation Airflow....: 5000.0 CFM
Dampers Open During Unocc Per.: N
Damper Leak Rate..............: 2 %
SUPPLY DUCT DATA
Duct Heat Gain................: 2 %
Duct Leakage Rate.............: 5 %
RETURN PLENUM DATA
Is a Return Plenum Used.......? N
SUPPLY FAN DATA
Fan Type......................: Forward Curved
Configuration.................: Draw-Thru
Fan Total Static..............: 0.90 in.wg.
Fan Efficiency................: 54 %
RETURN FAN DATA
Fan Type......................: None
OUTDOOR AIR ECONOMIZER
Outdoor Economizer Type.......: Integrated Dry-Bulb
OA Upper Cutoff Temp..........: 95.0 F
OA Lower Cutoff Temp..........: 0.0 F
PREHEAT COIL
Preheat Coil Used.............? N
PRECOOL COIL
Precool Coil Used.............? N
HUMIDIFICATION
Humidification System Used....? N
DEHUMIDIFICATION
Dehumidification System Used..? N
VENTILATION HEAT RECLAIM
Reclaim Unit Type.............: None
SAFETY FACTORS
Sensible Cooling Factor.......: 0 %
Latent Cooling Factor.........: 0 %
Heating Factor................: 0 %

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AIR SYSTEM INPUT DATA

Name: Auditorium - DDC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT

3. ZONE DATA

ZONE	1	(All Zones the Same)
T-Stat Occupied Cooling....(F):	75.0	
Unoccupied Cooling..(F):	85.0	
Occupied Heating....(F):	70.0	
Unoccupied Heating..(F):	55.0	
Throttling Range....(F):	3.0	
Zone Heating Unit Type........:	None	
Trip Temperature.........(F):	-	
Design Supply Temperature(F):	-	
Fan Total Static....(in.wg.):	-	
Fan Efficiency...........(%):	-	
Zone Terminal Type............:	Diffuser	
Reheat Coil.................?	N	
Direct Exhaust Airflow...(CFM):	0.0	
Direct Exhaust Fan kW.....(kW):	0.0	

4. SCHEDULE DATA

HOURLY TSTAT SCHEDULES	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Design Day............								X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Weekday...............								X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Saturday..............								X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Sunday................								X	X	X	X	X	X	X	X	X	X	X	X	X	X			

Cooling Available During Unoccupied Period ? Y

MONTHLY SCHEDULES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Central Heating........	XXX	XXX	XXX	XXX						XXX	XXX	XXX
Central Cooling........					XXX	XXX	XXX	XXX	XXX			

AIR SYSTEM INPUT DATA

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
1. East Perimeter - 1st Flr	1		
SPACES IN ZONE 2 (Zone 2)			
2. South Perimeter - 1st Fl	1		
SPACES IN ZONE 3 (Zone 3)			
3. West Perimeter - 1st Flr	1		
SPACES IN ZONE 4 (Zone 4)			
4. North Perimeter - 1st Fl	1		
SPACES IN ZONE 5 (Zone 5)			
6. East Perimeter - 2nd Flr	1		
SPACES IN ZONE 6 (Zone 6)			
7. South Perimeter - 2nd Fl	1		
SPACES IN ZONE 7 (Zone 7)			
8. West Perimeter - 2nd Flr	1		
SPACES IN ZONE 8 (Zone 8)			
9. North Perimeter - 2nd Fl	1		

AIR SYSTEM INPUT DATA

Name: Interior 219 - Baseline 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
5. Interior - 1st Flr	1	10. Interior - 2nd Flr	1

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
11. Auditorium	1		

AIR SYSTEM INPUT DATA

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
1. East Perimeter - 1st Flr	1		
SPACES IN ZONE 2 (Zone 2)			
2. South Perimeter - 1st Fl	1		
SPACES IN ZONE 3 (Zone 3)			
3. West Perimeter - 1st Flr	1		
SPACES IN ZONE 4 (Zone 4)			
4. North Perimeter - 1st Fl	1		
SPACES IN ZONE 5 (Zone 5)			
6. East Perimeter - 2nd Flr	1		
SPACES IN ZONE 6 (Zone 6)			
7. South Perimeter - 2nd Fl	1		
SPACES IN ZONE 7 (Zone 7)			
8. West Perimeter - 2nd Flr	1		
SPACES IN ZONE 8 (Zone 8)			
9. North Perimeter - 2nd Fl	1		

AIR SYSTEM INPUT DATA

Name: Interior 219 - PLC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
5. Interior - 1st Flr	1	10. Interior - 2nd Flr	1

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AIR SYSTEM INPUT DATA

Name: Auditorium - PLC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
11. Auditorium	1		

AIR SYSTEM INPUT DATA

Name: Fan Coil Units - DDC 12-30-94
Type: TERMINAL UNITS - 2-Pipe Fan Coils HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
1. East Perimeter - 1st Flr	1		
SPACES IN ZONE 2 (Zone 2)			
2. South Perimeter - 1st Fl	1		
SPACES IN ZONE 3 (Zone 3)			
3. West Perimeter - 1st Flr	1		
SPACES IN ZONE 4 (Zone 4)			
4. North Perimeter - 1st Fl	1		
SPACES IN ZONE 5 (Zone 5)			
6. East Perimeter - 2nd Flr	1		
SPACES IN ZONE 6 (Zone 6)			
7. South Perimeter - 2nd Fl	1		
SPACES IN ZONE 7 (Zone 7)			
8. West Perimeter - 2nd Flr	1		
SPACES IN ZONE 8 (Zone 8)			
9. North Perimeter - 2nd Fl	1		

AIR SYSTEM INPUT DATA

Name: Interior 219 - DDC | 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV | HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT | Page 1

****

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
5. Interior - 1st Flr	1	10. Interior - 2nd Flr	1

AIR SYSTEM INPUT DATA

Name: Auditorium - DDC 12-30-94
Type: CONSTANT VOLUME - Single Zone CAV HAP v3.04
Prepared by: EINHORN YAFFEE PRESCOTT Page 1

****

1. SPACE SELECTION

Space Name	Qty	Space Name	Qty
SPACES IN ZONE 1 (Zone 1)			
11. Auditorium	1		

PLANT INPUT DATA

Plant: Cooling Plant (Offices) - Base 12-30-94

Prepared By: EINHORN YAFFEE PRESCOTT Page 1

****

PLANT NAME, CLASSIFICATION & TYPE

Plant name..................	Cooling Plant (Offices) - Base
Classification..............	Cooling
Type........................	Air-Cooled Chiller
Type of simulation model....	Computer-Generated
Type of chiller.............	A/C Reciprocating

AIR SYSTEM SELECTIONS

Air System Name	Type	Quantity
1. Fan Coil Units - Baseline........	(2P-FC)	1
2. Interior 219 - Baseline..........	(SZ CAV)	1

AIR-COOLED RECIPROCATING CHILLER DATA

Estimated maximum cooling load...:	NA
Chiller capacity at design.......:	100.0 Tons
Chiller input power at design....:	1.500 kW/Ton
Chiller configuration............:	Mult. Compressors / Ckt., Unloaded
Is chilled water reset used......?	N
Is hot gas bypass used...........?	N
% load for minimum unloading.....:	20.0 %
Crankcase heater kW..............:	0.000 kW

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Efficiencies Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Chilled Water	11.2	70.00	70.0	80.0	5.04	0.0

PLANT INPUT DATA

PLANT NAME, CLASSIFICATION & TYPE

Plant name..................: Heating Plant - Baseline
Classification..............: Heating
Type........................: Hot Water Boiler

AIR SYSTEM SELECTIONS

Air System Name	Heating Coil Category Pre-Heat	Central	Terminal	Zone
1. Fan Coil Units - Baseline........	-	1	-	-
2. Interior 219 - Baseline..........	-	1	-	-
3. Auditorium - Baseline............	-	1	-	-

HOT WATER BOILER DATA

Estimated maximum heating load...: 854.0 MBH
Gross output at design...........: 2100.0 MBH
Energy input at design...........: 3500.0 MBH
Overall efficiency at design.....: 60.0 %
Fuel or energy type..............: Nat. Gas
Combustion air blower kW.........: 0.000 kW

BOILER PART-LOAD PERFORMANCE DATA

% Load	Overall Eff. (%)	% Load	Overall Eff. (%)
90	60.0	40	60.0
80	60.0	30	60.0
70	60.0	20	60.0
60	60.0	10	60.0
50	60.0	0	0.0

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Hot Water	20.0	70.00	70.0	80.0	4.94	0.0

PLANT INPUT DATA

Plant: Cooling (Auditorium) - Base 12-30-94

Prepared By: EINHORN YAFFEE PRESCOTT Page 1

PLANT NAME, CLASSIFICATION & TYPE

Plant name	Cooling (Auditorium) - Base
Classification	Cooling
Type	Air-Cooled Chiller
Type of simulation model	Computer-Generated
Type of chiller	A/C Reciprocating

AIR SYSTEM SELECTIONS

Air System Name	Type	Quantity
3. Auditorium - Baseline	(SZ CAV)	1

AIR-COOLED RECIPROCATING CHILLER DATA

Estimated maximum cooling load	NA
Chiller capacity at design	40.0 Tons
Chiller input power at design	1.250 kW/Ton
Chiller configuration	Mult. Compressors / Ckt., Unloaded
Is chilled water reset used?	N
Is hot gas bypass used?	N
% load for minimum unloading	20.0 %
Crankcase heater kW	0.000 kW

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Efficiencies Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Chilled Water	12.4	70.00	70.0	80.0	1.82	0.0

PLANT INPUT DATA

Plant: Cooling Plant (Offices) - PLC 12-30-94

Prepared By: EINHORN YAFFEE PRESCOTT Page 1

****

PLANT NAME, CLASSIFICATION & TYPE

Plant name..................: Cooling Plant (Offices) - PLC
Classification..............: Cooling
Type........................: Air-Cooled Chiller
Type of simulation model....: Computer-Generated
Type of chiller.............: A/C Reciprocating

AIR SYSTEM SELECTIONS

Air System Name	Type	Quantity
4. Fan Coil Units - PLC............	(2P-FC)	1
5. Interior 219 - PLC..............	(SZ CAV)	1

AIR-COOLED RECIPROCATING CHILLER DATA

Estimated maximum cooling load...: NA
Chiller capacity at design.......: 100.0 Tons
Chiller input power at design....: 1.500 kW/Ton
Chiller configuration............: Mult. Compressors / Ckt., Unloaded
Is chilled water reset used......? N
Is hot gas bypass used..........? N
% load for minimum unloading.....: 20.0 %
Crankcase heater kW..............: 0.000 kW

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Efficiencies Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Chilled Water	11.2	70.00	70.0	80.0	5.04	0.0

PLANT INPUT DATA

PLANT NAME, CLASSIFICATION & TYPE

Plant name..................: Heating Plant - PLC
Classification..............: Heating
Type........................: Hot Water Boiler

AIR SYSTEM SELECTIONS

	Heating Coil Category			
Air System Name	Pre-Heat	Central	Terminal	Zone
4. Fan Coil Units - PLC............	-	1	-	-
5. Interior 219 - PLC...............	-	1	-	-
6. Auditorium - PLC.................	-	1	-	-

HOT WATER BOILER DATA

Estimated maximum heating load...: 889.5 MBH
Gross output at design...........: 2100.0 MBH
Energy input at design...........: 3500.0 MBH
Overall efficiency at design.....: 60.0 %
Fuel or energy type..............: Nat. Gas
Combustion air blower kW.........: 0.000 kW

BOILER PART-LOAD PERFORMANCE DATA

% Load	Overall Eff. (%)	% Load	Overall Eff. (%)
90	60.0	40	60.0
80	60.0	30	60.0
70	60.0	20	60.0
60	60.0	10	60.0
50	60.0	0	0.0

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Efficiencies Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Hot Water	20.0	70.00	70.0	80.0	4.94	0.0

PLANT NAME, CLASSIFICATION & TYPE

Plant name..................: Cooling (Auditorium) - PLC
Classification..............: Cooling
Type........................: Air-Cooled Chiller
Type of simulation model....: Computer-Generated
Type of chiller.............: A/C Reciprocating

AIR SYSTEM SELECTIONS

Air System Name	Type	Quantity
6. Auditorium - PLC..................	(SZ CAV)	1

AIR-COOLED RECIPROCATING CHILLER DATA

Estimated maximum cooling load...: NA
Chiller capacity at design.......: 40.0 Tons
Chiller input power at design....: 1.250 kW/Ton
Chiller configuration............: Mult. Compressors / Ckt., Unloaded
Is chilled water reset used......? N
Is hot gas bypass used...........? N
% load for minimum unloading.....: 20.0 %
Crankcase heater kW..............: 0.000 kW

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Efficiencies Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Chilled Water	12.4	70.00	70.0	80.0	1.82	0.0

PLANT INPUT DATA

Plant: Cooling Plant (Offices) - DDC 12-30-94

Prepared By: EINHORN YAFFEE PRESCOTT Page 1

PLANT NAME, CLASSIFICATION & TYPE

Plant name..................: Cooling Plant (Offices) - DDC
Classification..............: Cooling
Type........................: Air-Cooled Chiller
Type of simulation model....: Computer-Generated
Type of chiller.............: A/C Reciprocating

AIR SYSTEM SELECTIONS

Air System Name	Type	Quantity
7. Fan Coil Units - DDC............	(2P-FC)	1
8. Interior 219 - DDC...............	(SZ CAV)	1

AIR-COOLED RECIPROCATING CHILLER DATA

Estimated maximum cooling load...: NA
Chiller capacity at design.......: 100.0 Tons
Chiller input power at design....: 1.500 kW/Ton
Chiller configuration............: Mult. Compressors / Ckt., Unloaded
Is chilled water reset used......? Y
Is hot gas bypass used...........? N
% load for minimum unloading.....: 20.0 %
Crankcase heater kW..............: 0.000 kW

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Efficiencies Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Chilled Water	11.2	70.00	70.0	80.0	5.04	0.0

PLANT INPUT DATA

PLANT NAME, CLASSIFICATION & TYPE

Plant name..................: Heating Plant - DDC
Classification..............: Heating
Type........................: Hot Water Boiler

AIR SYSTEM SELECTIONS

Air System Name	Heating Coil Category Pre-Heat	Central	Terminal	Zone
7. Fan Coil Units - DDC............	-	1	-	-
8. Interior 219 - DDC..............	-	1	-	-
9. Auditorium - DDC................	-	1	-	-

HOT WATER BOILER DATA

Estimated maximum heating load...: 889.5 MBH
Gross output at design...........: 2100.0 MBH
Energy input at design...........: 3500.0 MBH
Overall efficiency at design.....: 60.0 %
Fuel or energy type..............: Nat. Gas
Combustion air blower kW.........: 0.000 kW

BOILER PART-LOAD PERFORMANCE DATA

% Load	Overall Eff. (%)	% Load	Overall Eff. (%)
90	60.0	40	60.0
80	60.0	30	60.0
70	60.0	20	60.0
60	60.0	10	60.0
50	60.0	0	0.0

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Hot Water	20.0	70.00	70.0	80.0	4.94	0.0

PLANT INPUT DATA

Plant: Cooling (Auditorium) - DDC 12-30-94

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PLANT NAME, CLASSIFICATION & TYPE

Plant name..................:	Cooling (Auditorium) - DDC
Classification..............:	Cooling
Type........................:	Air-Cooled Chiller
Type of simulation model....:	Computer-Generated
Type of chiller.............:	A/C Reciprocating

AIR SYSTEM SELECTIONS

Air System Name	Type	Quantity
9. Auditorium - DDC.................	(SZ CAV)	1

AIR-COOLED RECIPROCATING CHILLER DATA

Estimated maximum cooling load...:	NA
Chiller capacity at design.......:	40.0 Tons
Chiller input power at design....:	1.250 kW/Ton
Chiller configuration............:	Mult. Compressors / Ckt., Unloaded
Is chilled water reset used......?	N
Is hot gas bypass used...........?	N
% load for minimum unloading.....:	20.0 %
Crankcase heater kW..............:	0.000 kW

PUMP AND PIPING SYSTEM DATA

Pump or Piping System	Delta-T (F)	Pump Head (ft wg)	Efficiencies Mech (%)	Efficiencies Elec (%)	Pump Power (kW)	Piping Gain/Loss (%)
Chilled Water	12.4	70.00	70.0	80.0	1.82	0.0

BUILDING INPUT DATA

BUILDING NAME..........: Building 219 - Baseline

PLANT SELECTION

	Plant Name	Type	Quantity
1.	Cooling Plant (Offices) - Base.	(A/C CHILLER)	1
2.	Heating Plant - Baseline.......	(HW BOILER)	1
3.	Cooling (Auditorium) - Base....	(A/C CHILLER)	1

MISCELLANEOUS ELECTRIC POWER USE

Reference Name	Max. Power Use (kW)	Schedule Name
Empty...	0.0	NA
Empty...	0.0	NA
Empty...	0.0	NA
Empty...	0.0	NA

MISCELLANEOUS FUEL USE

Reference Name	Fuel Type	Fuel Units	Conversion kBTU/Units	Max. Use	Schedule Name
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA

Fuel Types: NG=Nat.Gas FO=Fuel Oil PR=Propane RH=Rmt Htg

ELECTRIC RATE

Electric rate.................: Ft. Belvoir Equivalent $/kWh
Average building power factor.: NA

FUEL RATES

Natural gas...................: Washington Gas Rate Schedule 2
Fuel oil......................: None
Propane.......................: None
Remote source heating.........: None
Remote source cooling.........: None

****

MISCELLANEOUS DATA

Additional building floor area.....................: 0.0 sqft
Source electric generating efficiency.............: 100.00 %

BUILDING INPUT DATA

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BUILDING NAME..........: Building 219 - PLC

PLANT SELECTION

Plant Name	Type	Quantity
4. Cooling Plant (Offices) - PLC..	(A/C CHILLER)	1
5. Heating Plant - PLC...........	(HW BOILER)	1
6. Cooling (Auditorium) - PLC.....	(A/C CHILLER)	1

MISCELLANEOUS ELECTRIC POWER USE

Reference Name	Max. Power Use (kW)	Schedule Name
Empty...	0.0	NA
Empty...	0.0	NA
Empty...	0.0	NA
Empty...	0.0	NA

MISCELLANEOUS FUEL USE

Reference Name	Fuel Type	Fuel Units	Conversion kBTU/Units	Max. Use	Schedule Name
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA

Fuel Types: NG=Nat.Gas FO=Fuel Oil PR=Propane RH=Rmt Htg

ELECTRIC RATE

Electric rate.................: Ft. Belvoir Equivalent $/kWh
Average building power factor.: NA

FUEL RATES

Natural gas...................: Washington Gas Rate Schedule 2
Fuel oil......................: None
Propane.......................: None
Remote source heating.........: None
Remote source cooling.........: None

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MISCELLANEOUS DATA

Additional building floor area....................:	0.0 sqft
Source electric generating efficiency.............:	100.00 %

BUILDING INPUT DATA

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BUILDING NAME..........: Building 219 - DDC

PLANT SELECTION

Plant Name	Type	Quantity
7. Cooling Plant (Offices) - DDC..	(A/C CHILLER)	1
8. Heating Plant - DDC...........	(HW BOILER)	1
9. Cooling (Auditorium) - DDC.....	(A/C CHILLER)	1

MISCELLANEOUS ELECTRIC POWER USE

Reference Name	Max. Power Use (kW)	Schedule Name
Empty...	0.0	NA
Empty...	0.0	NA
Empty...	0.0	NA
Empty...	0.0	NA

MISCELLANEOUS FUEL USE

Reference Name	Fuel Type	Fuel Units	Conversion kBTU/Units	Max. Use	Schedule Name
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA
Empty...	NG	THM	100.0000	0.0	NA

Fuel Types: NG=Nat.Gas FO=Fuel Oil PR=Propane RH=Rmt Htg

ELECTRIC RATE

Electric rate.................: Ft. Belvoir Equivalent $/kWh
Average building power factor.: NA

FUEL RATES

Natural gas...................: Washington Gas Rate Schedule 2
Fuel oil......................: None
Propane.......................: None
Remote source heating.........: None
Remote source cooling.........: None

****
MISCELLANEOUS DATA

Additional building floor area....................:	0.0 sqft
Source electric generating efficiency.............:	100.00 %